

# SYMPHENIA

## A dynamic symphony of perceptions

Project Proposal

DART499 / CART499 / DART631

Convergence: Arts, Neuroscience, and Society

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### Neuroscience Background

#### *Believing is seeing*

In contrast with many mammals, modern humans predominantly rely on vision to analyze their environment instead of other senses like smell, taste, and touch. This commonly leads us to believe that what we see reflects reality. However, it has been demonstrated that our visual impression of the world is the result of Bayesian inferences performed by our brain,<sup>1</sup> often resulting in our “perception being shaped by our expectation”.<sup>2</sup> The neural interpretation of sensory information is based on external cues and previously integrated knowledge, as well as influenced by other individuals. These inferential illusory representations are cooperatively computed by all sensory systems and concern all dimensions of perception. To build a seemingly complete and continuous picture, our brains can represent things that are not sensed, for example in visual filling-in effects.<sup>3</sup> Throughout evolution, our brains have developed a high efficiency in recognizing certain patterns, to such an extent that we observe somewhere there are none. Unsurprisingly, these misleading perceptions have also become a source of creativity.<sup>4</sup> Finally, the brain can project perceptions onto itself, without any physical stimulation, for instance in dreams. Often seen as bizarre, but never fully unexplainable, dreams are a great example of unconstrained naive generation in the brain’s circuitry.<sup>5</sup> Even though dreams or mind-wandering appear more chaotic to us than the outside world, which seems more continuous and harmonious, all those representations are mere illusions produced by our brain at different levels of constraint. We call this ensemble of illusions *sympheonia*, as it is the product of our brain turning conglomerations of mental ideations and physical stimulations into an inherently and momentarily coherent global representation.

### Keywords

Bayesian perception, apophenia, change blindness, mind wandering, neural network dynamics

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<sup>1</sup> Sclar, L. E.; Gillies, D. F. *Probabilistic Reasoning in High-Level Vision*. Image and Vision Computing 1994, 12 (1), 42–60.

<sup>2</sup> Otten, M.; Seth, A. K.; Pinto, Y. *Seeing  $\mathcal{O}$ , Remembering C: Illusions in Short-Term Memory*. PLoS One 2023, 18 (4), e0283257.

<sup>3</sup> Cohen, M. A.; Botch, T. L.; Robertson, C. E. *The Limits of Color Awareness during Active, Real-World Vision*. Proceedings of the National Academy of Sciences 2020, 117 (24), 13821–13827.

<sup>4</sup> Wisher, I.; Pettitt, P.; Kentridge, R. *The Deep Past in the Virtual Present: Developing an Interdisciplinary Approach towards Understanding the Psychological Foundations of Palaeolithic Cave Art*. Sci Rep 2023, 13 (1), 19009.

<sup>5</sup> Northoff, G.; Scalabrini, A.; Fogel, S. *Topographic-Dynamic Reorganisation Model of Dreams (TRoD) – A Spatiotemporal Approach*. Neuroscience & Biobehavioral Reviews 2023, 148, 105117.

## Art-Science Proposition

Our project aims to present the audience with that symphenia. We want the public to explore representations of perception and attention. *Symphenia*'s panel is our metaphor for the mind, its mechanical pistons illustrating the cognitive switch between the default mode network (DMN) and central executive network (CEN). They wander and converge. The salient event is the click of the piston drawing our interest. The silhouette is the attentional spotlight in Baars' Theatre of Consciousness.<sup>6</sup> The chromatic imprint layered on top is the cognitive representation of our perception taking shape as colours converge to one hue. As this imprint fades, it also evokes apophenia; the persistence of silhouettes leads us to question what perceived patterns are the vestiges of others or our own symphenic projections.

*Symphenia* is an enchanting speculation of perception. Through enticing sounds, the viewer grasps their instantaneous effect on the artwork; visual fascination makes it longer-lasting. When others subsequently interact with it, they layer their own experience on the evanescent imprints of others. This echoes the communal aspect of our piece, adding to the humanistic view of perception and interaction we want to convey.

To showcase these complex probabilistic processes within the MUHC Glen Site's atrium, we must acknowledge the intricacies of our context. For example, the public going through a medical institution will not necessarily seek art, let alone interactive art. Because we live in a visually saturated era in which people spend little time on individual artworks,<sup>7</sup> creating a piece that captivates and motivates interaction became crucial to our goal. We therefore seek to build a piece that is activated regardless of the audience's awareness while also providing a strong incentive to enrich their experience through embodied interactivity.

Concretely, *Symphenia* is an interactive sculpture harnessing computational and robotic art. The piece contains an array of hexagonal elements mounted on linear actuators and backlit by LEDs, assembled onto a panel. At rest, all linear actuators are fully extended and the RGB ratios of the LEDs vary chaotically. The custom-fabricated hexagons are 3D printed in translucent resin, diffusing the light source. Finally, a camera mounted above the panel provides a depth image of passersby in real-time. This depth image is mapped onto the array of linear actuators, which retract within the outline of the imprinted silhouette. The passerby's attention is thus first solicited via the immediate salience of sharp mechanical sounds.

Upon closer inspection, they recognize their silhouette in the imprinted depth map. If they linger, they also notice that the seemingly chaotic colour pattern within that imprint gradually converges towards the dominant colour component, amplifying the immediate acoustic effect of the mechanism through gradual visual variation. This behavioural change emerges from the Durcheinander rate, our ad hoc algorithm which serves as the computational scaffolding for the audiovisual representation of ostensibly chaotic yet algorithmically deterministic patterns.<sup>8</sup> Similarly, once the passerby exits the visual field of the camera, the linear actuators return to their default extended position immediately, while the LEDs slowly regress to chaotic variation, lingering longer and leaving traces of our time with the piece.

Budget [Annex 1]

Timeline [Annex 2]

Maquette [Annex 3]

References [Annex 4]

[\*World Skies Pink Sunset\*](#) (Breakfast Studio, 2023) - Flip-Discs, software, camera, computer

[\*Pulse Room\*](#) (Rafael Lozano-Hemmer, 2006) - Lightbulbs, voltage controllers, HR sensors, computer

[\*r/Place\*](#) (Josh Wardle, 2017) - Custom software

[\*G80\*](#) (Fragmentin, 2023) - Aluminium, plexiglass, painted sliders, computer, electronic components

[\*Machine Hallucination\*](#) (Refik Anadol, 2022) - AI Data Sculpture, Video loop, NFT, LED screen

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<sup>6</sup> Baars, Bernard J. In the Theater of Consciousness : The Workspace of the Mind. New York: Oxford University Press, 1997.

<sup>7</sup> Smith, Jeffrey K., and Lisa F. Smith. "Spending time on art." Empirical studies of the arts 19, no. 2 (2001): 229-236.

<sup>8</sup> Taken from one translation of *chaos* in German and a compound word of *durch* (through) and *einander* (eachother), the Durcheinander rate evolves as a function of whether people are goal-oriented towards it (by standing in front of it and making its Durcheinander rate decrease) or not (if there is no one in front, making its Durcheinander rate increase until it plateaus).

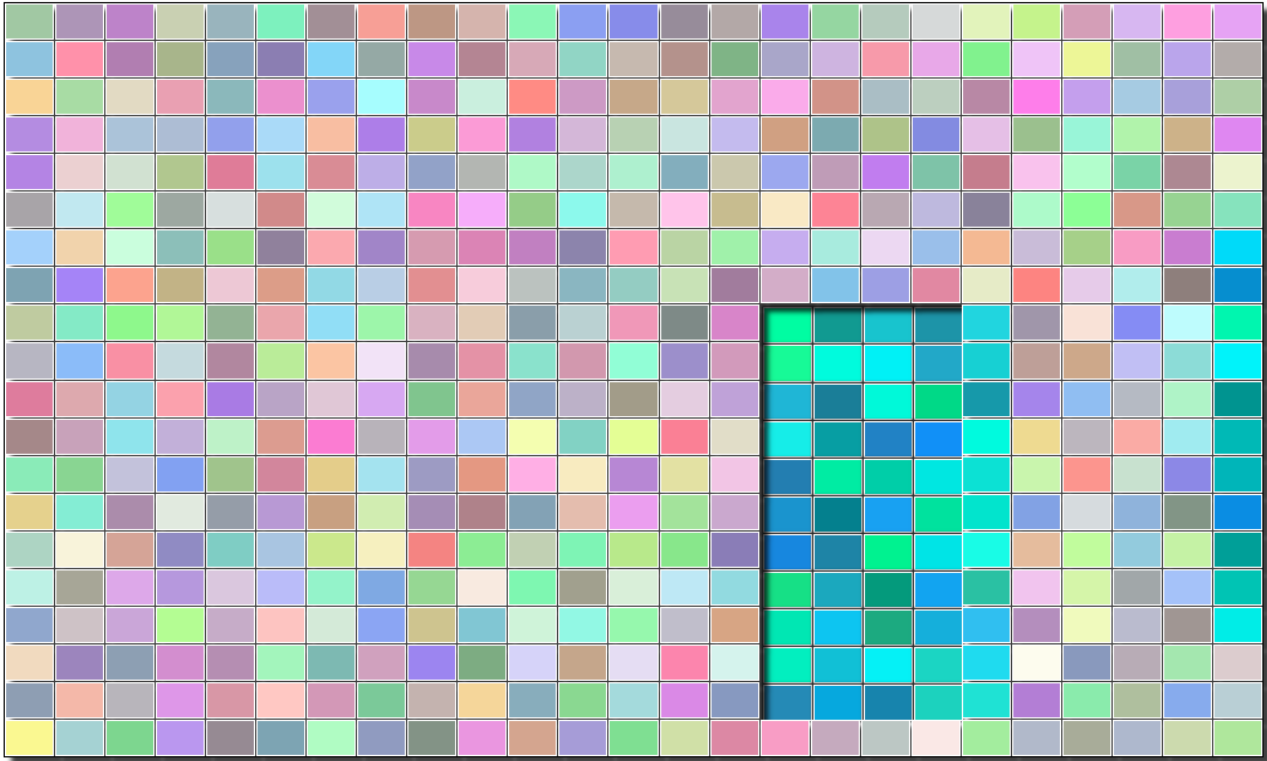
## Annex 1 - Budget

Convergence - Chaos - Budget							
Item	Provider	ID	Unit price	Qty	Ext price	GST/HST	Rounded
<b>FEES</b>							
Workshop (electronics)	tbd		CA\$ 200.00	9	CA\$ 1,800.00	CA\$ 1,800.00	in kind
Fabrication technician	Digifab CTC		CA\$ 35.00	20	CA\$ 700.00	CA\$ 700.00	in kind
Photo/videographer	tbd	CADA/East	CA\$ 30.00	5	CA\$ 150.00	CA\$ 150.00	in kind
					<b>SUBTOTAL</b>	<b>CA\$ 2,650.00</b>	<b>CA\$ -</b>
<b>EQUIPMENT</b>							
Mac Mini	CDA		CA\$ 1,200.00	1	CA\$ 1,200.00	CA\$ 1,200.00	in kind
Electronic toolset	artists		CA\$ 700.00	1	CA\$ 700.00	CA\$ 700.00	in kind
Max/MSP license	Cycling '74	yearly, prorated	CA\$ 100.00	1	CA\$ 100.00	CA\$ 100.00	in kind
Arduino license	Arduino	Open-source	CA\$ -	1	CA\$ -	CA\$ -	in kind
					<b>SUBTOTAL</b>	<b>CA\$ 800.00</b>	<b>CA\$ -</b>
<b>FABRICATION</b>							
MDF 1/8" / f'2	CTC woodshop		CA\$ 0.75	22	CA\$ 16.50	CA\$ 18.97	CA\$ 19.00
Plywood 1/8" / f'2	CTC woodshop		CA\$ 1.90	22	CA\$ 41.80	CA\$ 48.06	CA\$ 48.00
PLA / g	CTC Digifab		CA\$ 0.05	660	CA\$ 330.00	CA\$ 379.42	CA\$ 379.00
PVA / g	CTC Digifab		CA\$ 0.25	0	CA\$ -	CA\$ -	CA\$ -
Resin / mL	CTC Digifab		CA\$ 0.34	0	CA\$ -	CA\$ -	CA\$ -
Screws, bolts, washers	Rona	(tbd)	CA\$ 50.00	1	CA\$ 50.00	CA\$ 57.49	CA\$ 57.00
Glue, zipties, tape	Rona	(tbd)	CA\$ 40.00	1	CA\$ 40.00	CA\$ 45.99	CA\$ 46.00
					<b>SUBTOTAL</b>	<b>CA\$ 549.93</b>	<b>CA\$ 549.00</b>
<b>ELECTRONICS</b>							
Solenoid Electromagnet 12VDC	ABRA	<a href="#">SOL-12V2A20</a>	CA\$ 9.95	300	CA\$ 2,985.00	CA\$ 3,432.00	CA\$ 3,432.00
LED strips	ABRA	<a href="#">LED-STRIP-1</a>	CA\$ 26.95	12	CA\$ 323.40	CA\$ 371.83	CA\$ 372.00
Adafruit Mini Skinny NeoPixel Dig	Adafruit	<a href="#">ADA-2949</a>	CA\$ 23.00	0	CA\$ -	CA\$ -	CA\$ -
Arduino Uno	ABRA	<a href="#">ABX00080</a>	CA\$ 29.95	4	CA\$ 119.80	CA\$ 137.74	CA\$ 138.00
Arduino Mega	ABRA	<a href="#">A000067</a>	CA\$ 59.95	4	CA\$ 239.80	CA\$ 275.71	CA\$ 276.00
Wire	ABRA	n/a	CA\$ 50.00	1	CA\$ 50.00	CA\$ 57.49	CA\$ 57.00
Headers	ABRA	n/a	CA\$ 20.00	1	CA\$ 20.00	CA\$ 23.00	CA\$ 23.00
Protoboards	ABRA	n/a	CA\$ 8.00	10	CA\$ 80.00	CA\$ 91.98	CA\$ 92.00
Resistors	ABRA	n/a	CA\$ 27.54	3	CA\$ 82.62	CA\$ 94.99	CA\$ 95.00
Capacitors	ABRA	n/a	CA\$ 25.24	3	CA\$ 75.72	CA\$ 87.06	CA\$ 87.00
Solder	ABRA	S031	CA\$ 26.08	1	CA\$ 26.08	CA\$ 29.99	CA\$ 30.00
Solder tips	ABRA	SI-TIP-KIT15	CA\$ 32.91	1	CA\$ 32.91	CA\$ 37.84	CA\$ 38.00
Solder tip cleaner	ABRA	SA-100	CA\$ 8.45	1	CA\$ 8.45	CA\$ 9.72	CA\$ 10.00
protective enclosures	ABRA	(various)	CA\$ 50.00	1	CA\$ 50.00	CA\$ 57.49	CA\$ 57.00
Wall wart 12V 1.5A	ABRA	DC-121.5-2.1	CA\$ 9.95	3	CA\$ 29.85	CA\$ 34.32	CA\$ 34.00
Wall wart 9V 1A	ABRA	63-ADA	CA\$ 13.37	3	CA\$ 40.11	CA\$ 46.12	CA\$ 46.00
DC jack 2.1mm mount	ABRA	31-157-0	CA\$ 2.19	8	CA\$ 17.52	CA\$ 20.14	CA\$ 20.00
DC jack 2.1mm breakout	ABRA	PP-120	CA\$ 1.53	8	CA\$ 12.24	CA\$ 14.07	CA\$ 14.00
					<b>SUBTOTAL</b>	<b>CA\$ 3,432.00</b>	<b>CA\$ 3,432.00</b>
					<b>TOTAL</b>	<b>CA\$ 6,631.93</b>	<b>CA\$ 3,981.00</b>

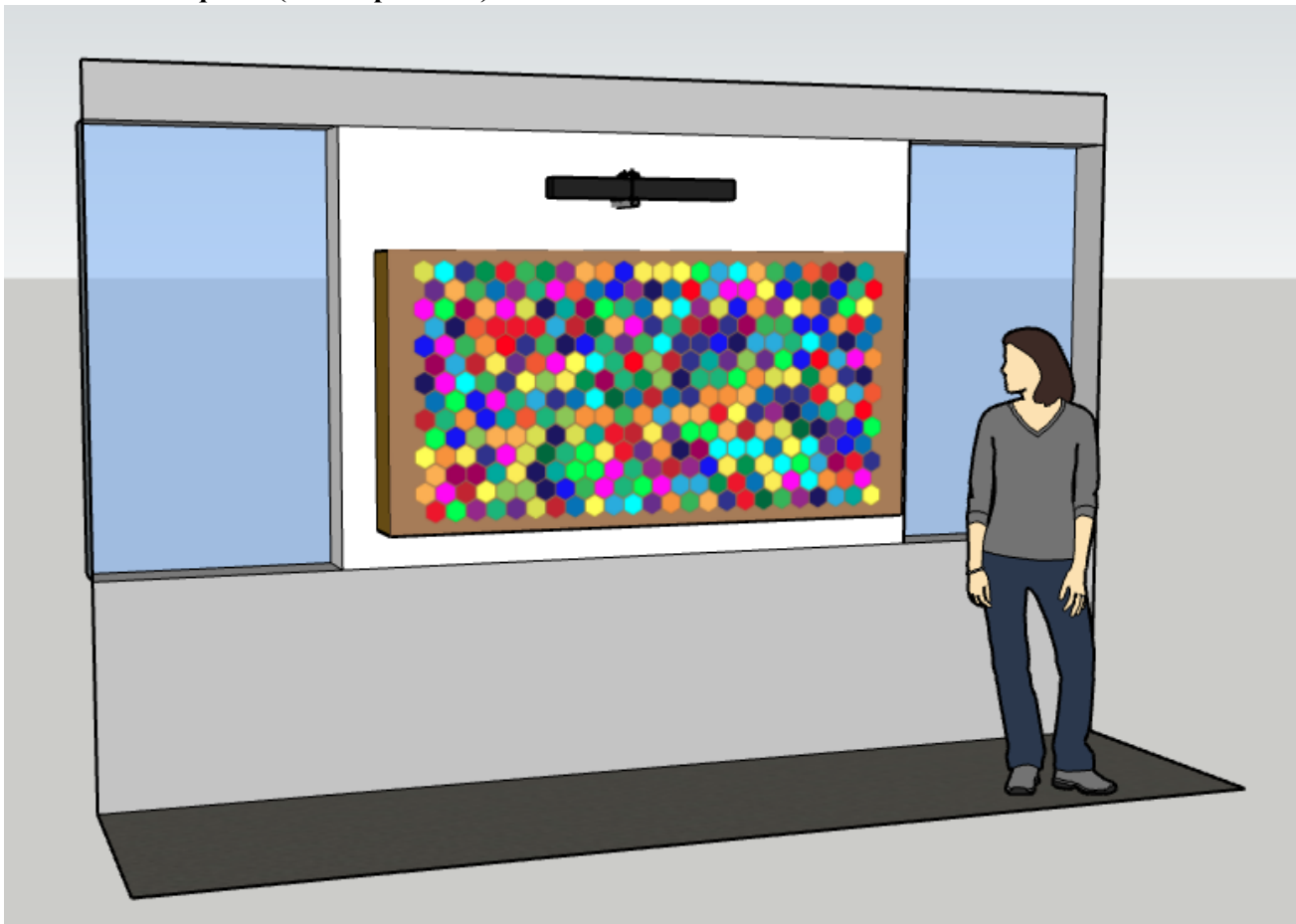
## Annex 2 - [Timeline](#)

Symphenia - Timeline				
Antoine, illiez, Liana, Sarah				
Date		Type	Activity	State
Fall 2023				
...		...	...	...
Dec 4			Classes end	
Dec 7		ACD	Proposal due	WIP
Dec 8		ACD	Powerpoint presentation	WIP
Winter 2024				
Dec 19 - Jan 5		ADM	away - illiez	
Dec 22 - Jan 12		ADM	away - Antoine	
Jan 12 - Jan 21		ADM	away - Liana	
Jan 15			Classes begin	
Jan 15		ADM	Meeting with Elio Bidinost (CART)	NO
Jan 19		ACD	Class - The White Box	NO
Jan 20?		FIN	CSU External Mobilization Funding	NO
Jan 21		ART	Prototype linear reciprocating actuator (piston, solenoid, slider)	NO
Jan 26		ACD	Class - The Black Box	NO
Jan 27		FIN	CUAA Student Project Fund application	NO
Jan 28		ART	Prototype luminescence (LED, fiber optic)	NO
2/2/2024?		FIN	FASA Special Project Grant - Winter	NO
Feb 2		ACD	Class - Meetings	NO
Feb 4		ART	Prototype hexagon (3D model & print)	NO
Feb 5		FIN	CCSL Special Project Funding - Winter	NO
Feb 9		ACD	Class - Meetings	NO
Feb 11		ART	Prototype assembled mechanism (hexagon + linear actuator)	NO
Feb 16		ACD	Class - Meetings	NO
Feb 18		ART	Prototype programming (camera + mechanism)	NO
Feb 23		ACD	Class - Meetings	NO
Feb 26		ADM	Reading week begins	
Mar 3		ADM	Reading week ends	
Mar 3		ART	Prototype full small-scale	NO
Mar 8		ACD	Class - Meetings	NO
Mar 8?		FIN	CSU Special Project Funding	NO
Mar 15		ACD	Class - Meetings	NO
Mar 17		ART	Fabricate panel & enclosure (CNC, laser cut)	NO
Mar 22		ACD	Class - Meetings	NO
Mar 24		ART	Complete assembly/installation	NO
Mar 24		FIN	CUAA Student Project Fund - 4/4	NO
Apr 5		ACD	Class - Meetings	NO
Apr 7		ART	Finish testing & debugging	NO
Apr 12		ART	Final deadline for finished pieces	NO
Apr 15		ADM	Classes end	
Apr 18		ART	Exhibition install	NO
Apr 19		ADM	Exhibition start	NO
Apr 19		ADM	Exhibition vernissage	NO
Apr 20		ART	Document artwork	NO
May 2		ADM	Exhibition end	NO
May 2		ART	Exhibition tear-down	NO
May 2		ADM	Return Equipment	NO
Apr 25 - May 1		FIN	Prepare Funding Reports	NO
Apr 30, 2022		FIN	Submit CSU SPF receipts	NO
May 5, 2022		FIN	Submit CSU report	NO

Annex 3.1 - Maquette ([Programming wireframe](#))

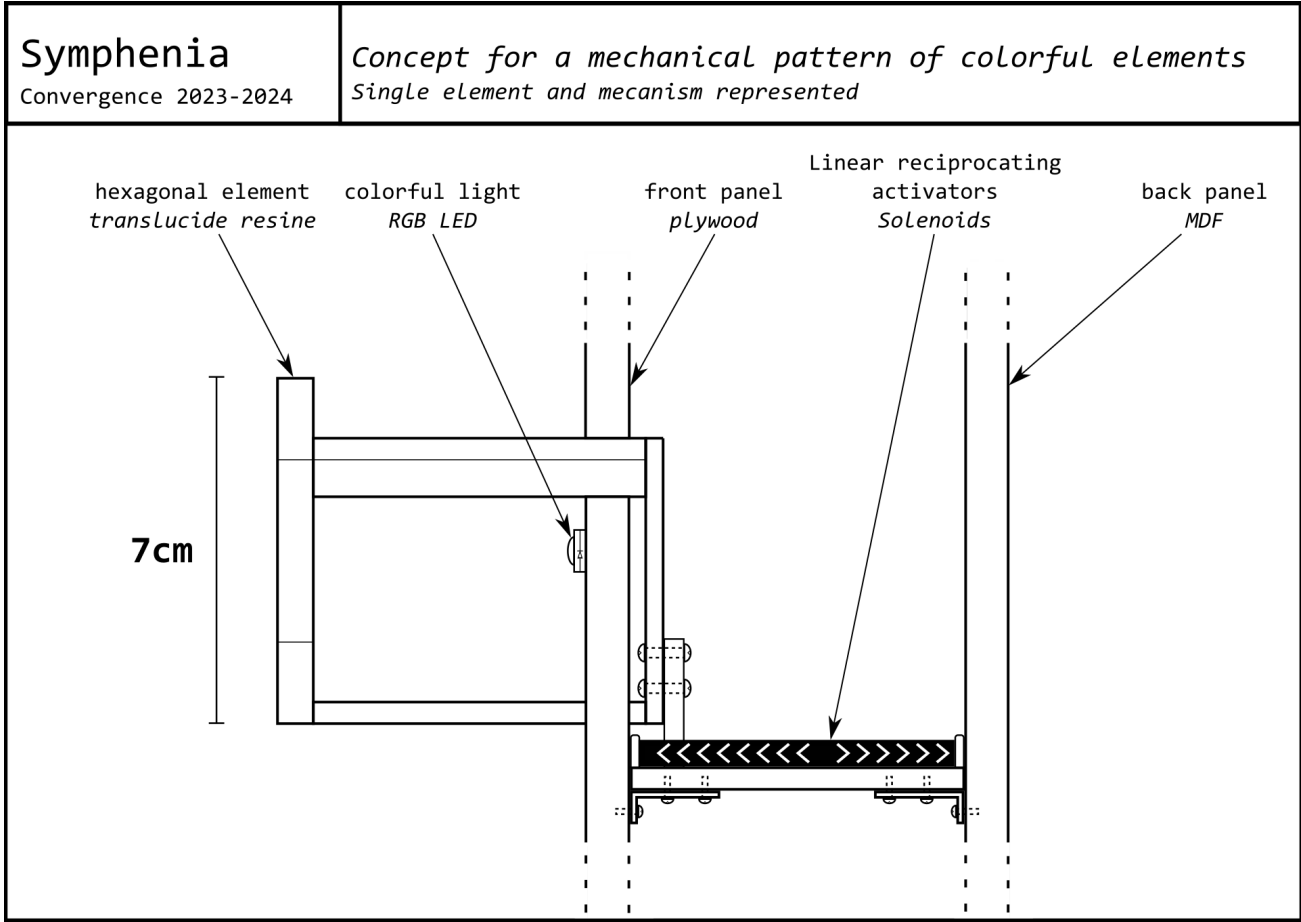


Annex 3.2 - Maquette (Mockup render)

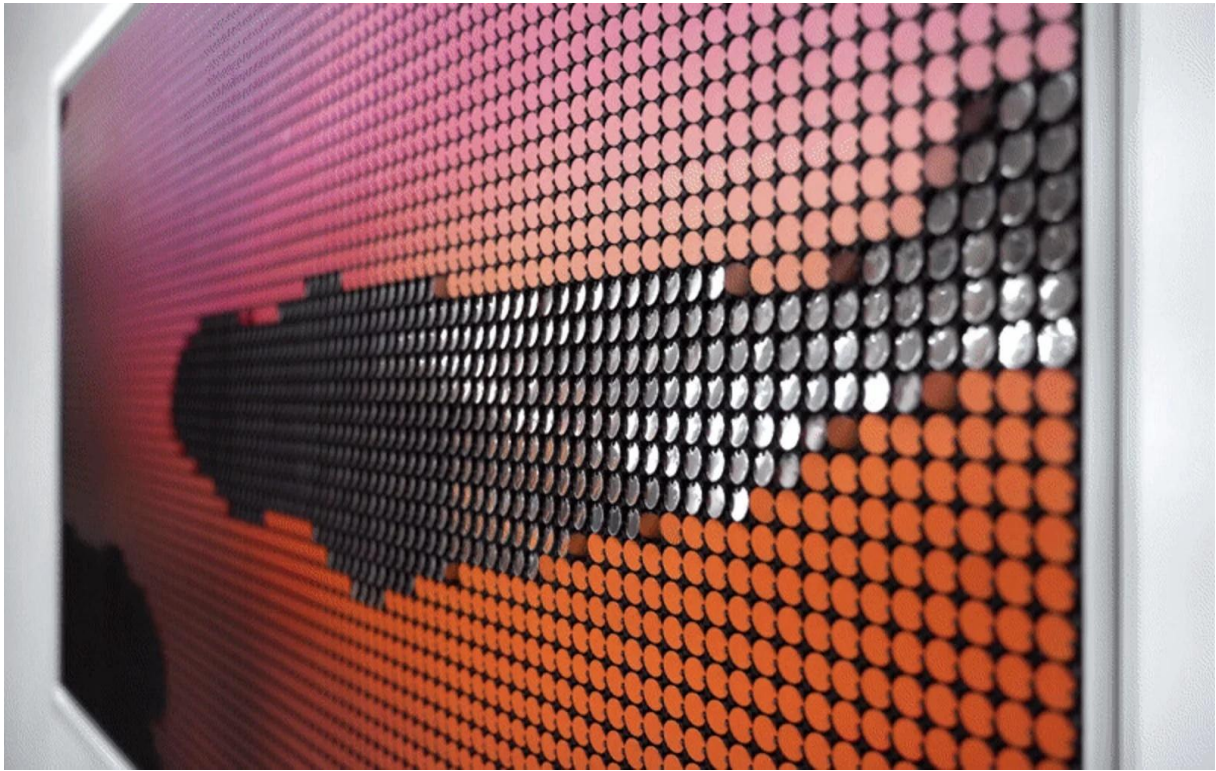




Annex 3.3 - Maquette (Technical drawing)



Annex 4.1 - Reference - World Skies Pink Sunset (Breakfast Studio, 2023)





**Annex 4.2 - Reference - Pulse Room (Rafael Lozano-Hemmer, 2006)**



**Annex 4.3 - Reference - r/Place (Josh Wardle, 2017)**



**Annex 4.4 - Reference - G80 (Fragmentin, 2023)**



**Annex 4.5 - Reference - Machine Hallucination (Refik Anadol, 2022)**

