

# Lifting the Veil: Visualizing Sentient Architecture

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# Outline

- ▶ Background: What is Sentient Architecture?
- ▶ Example projects:
  - ▶ „Lifting the Veil“
  - ▶ „Dendrite“
- ▶ Demo
- ▶ Outlook: I-SIDE



# What is Sentient Architecture?





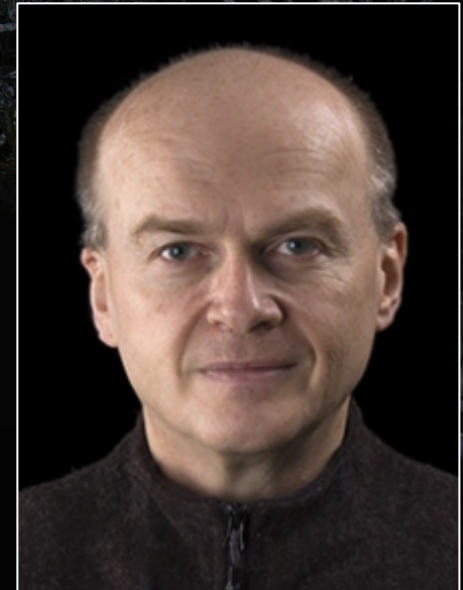
Sentient Chamber, National Academy of Sciences, Washington, D.C. (2016)



# What is Sentient Architecture?

- ▶ Intelligent systems
  - ▶ Sensors
    - ▶ Infrared (IR)
    - ▶ Microphone
  - ▶ Actuators
    - ▶ Kinetic
    - ▶ Light
    - ▶ Sound
  - ▶ Processors

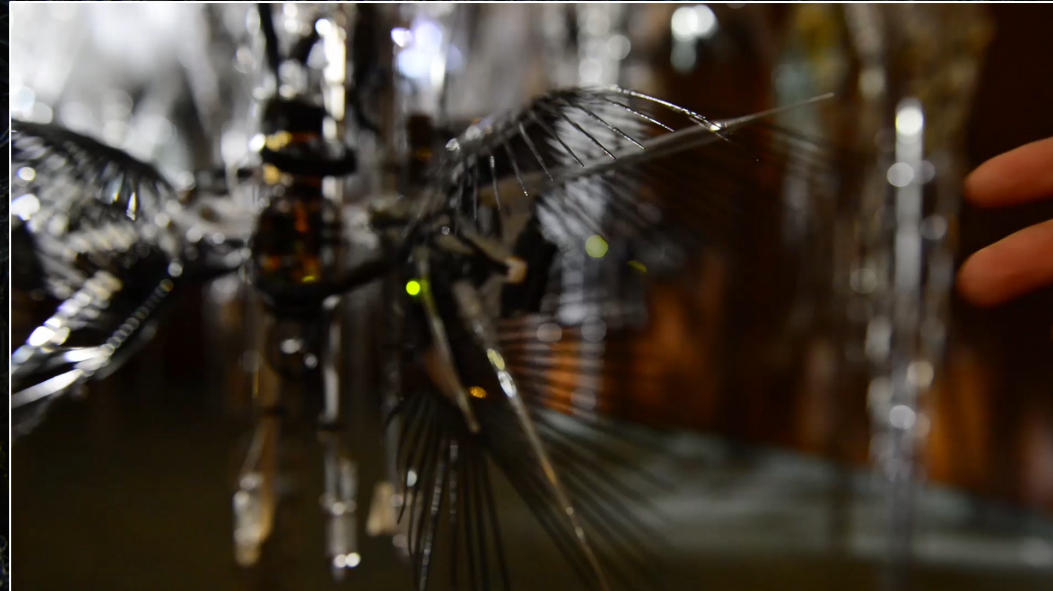
Philip Beesley



[https://uwaterloo.ca/architecture/sites/ca.architecture/files/styles/sidebar-220px-wide/public/uploads/images/P\\_Beesley\\_0.jpg?itok=vp0HUR05](https://uwaterloo.ca/architecture/sites/ca.architecture/files/styles/sidebar-220px-wide/public/uploads/images/P_Beesley_0.jpg?itok=vp0HUR05)



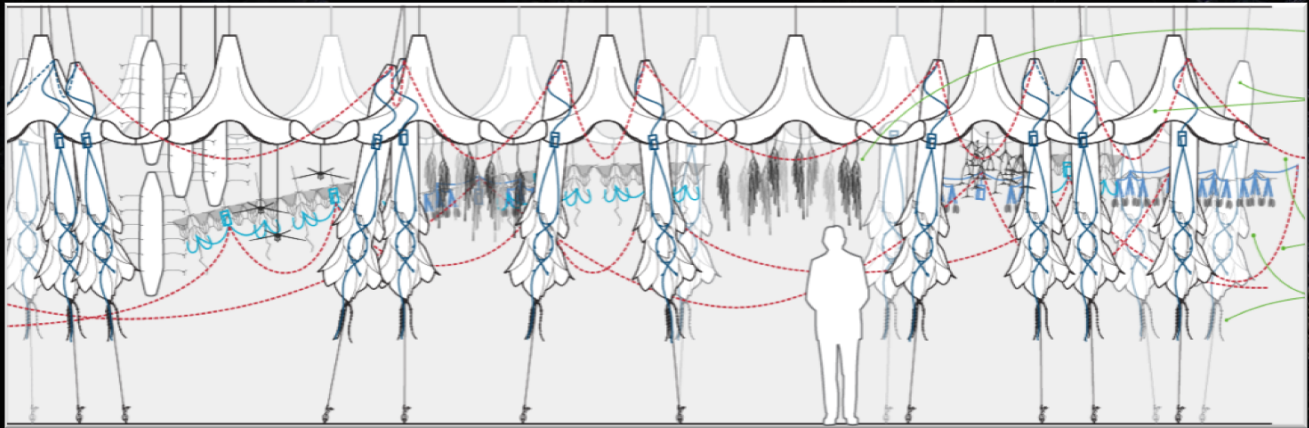
# What is Sentient Architecture?



Sensor (IR)

Actuators (light + kinetic)





Drawing of a test-bed with architectural prototypes

Internet of Things?

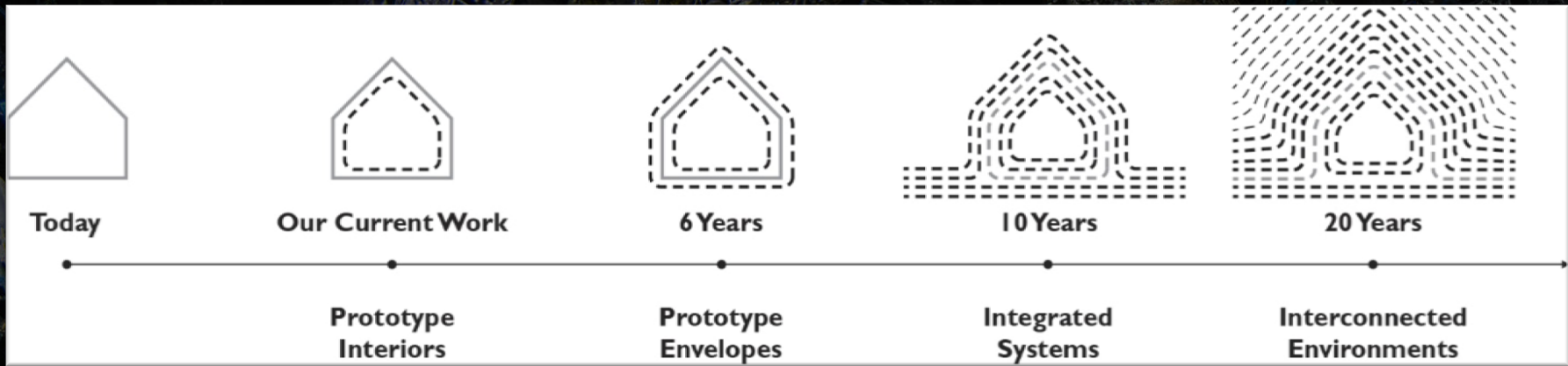


Diagram of LASG and Information Visualization Lab's long-term evolution of prototyped Living Architecture, accompanied by complex system visualizations, expanding from interiors, to exteriors, to interconnected buildings and environments.



What do we do with this?

Our research domains:

- Data flow
- Structure, dynamics, state
- Educate users through data visualizations



# Our Expertise: Macroscopes



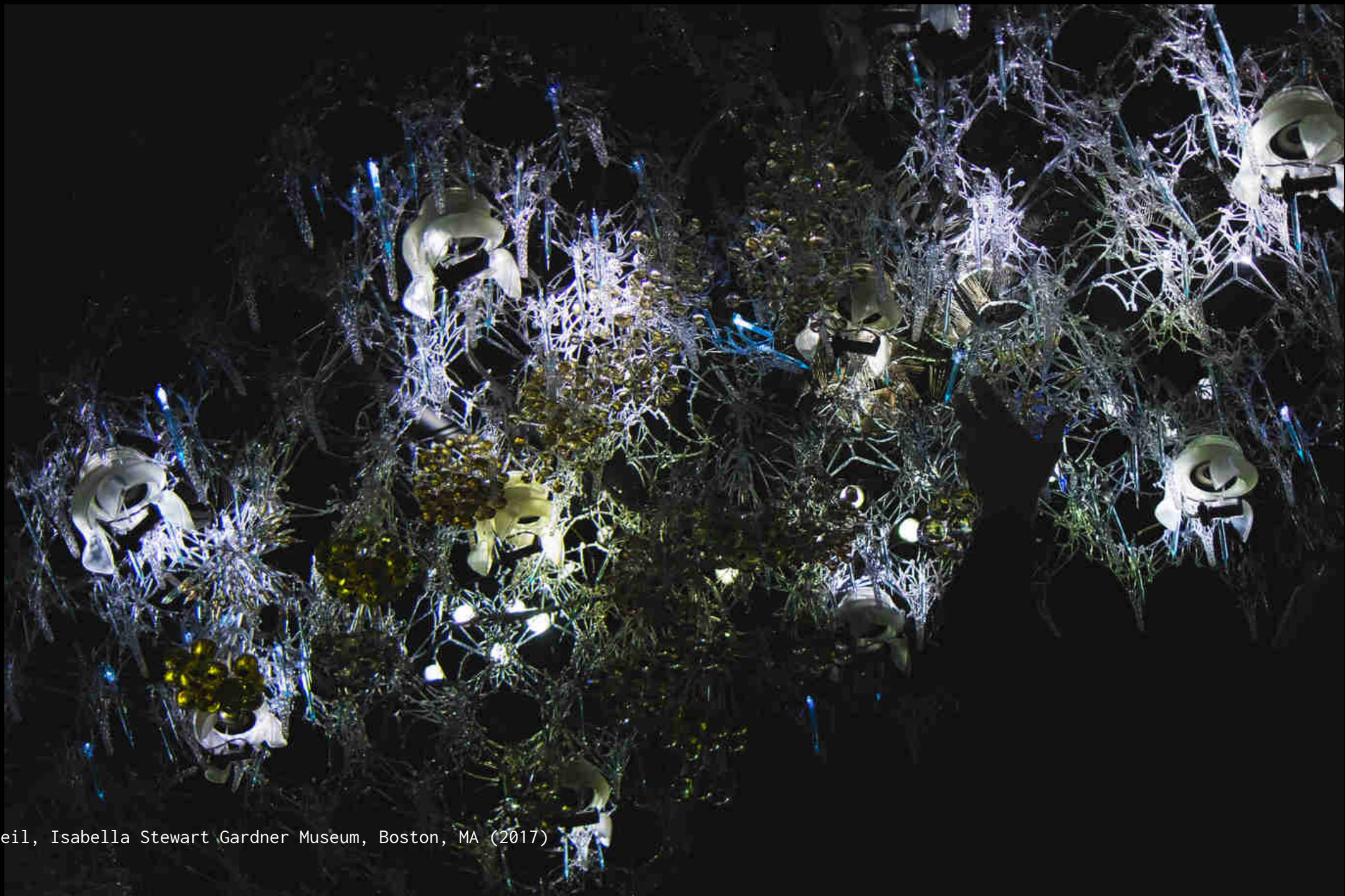
Source: <https://www.youtube.com/watch?v=Ef3tAxoW9mE>



## Example project 1: “Lifting the Veil”

- ▶ „Sentient Veil“ sculpture in Boston, MA (USA)
- ▶ Allow visitors insights
- ▶ Artful intelligent system
- ▶ Data visualization literacy





Sentient Veil, Isabella Stewart Gardner Museum, Boston, MA (2017)





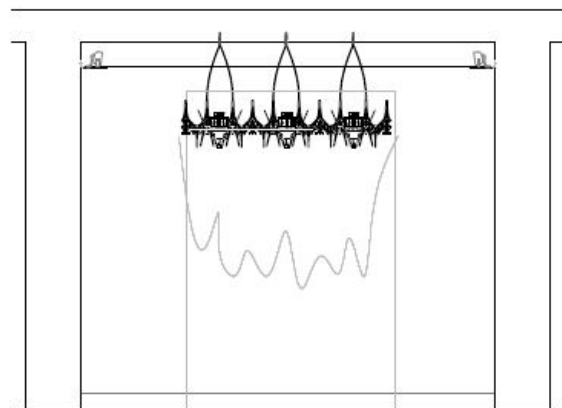
Sentient Veil, Isabella Stewart Gardner Museum, Boston, MA (2017)



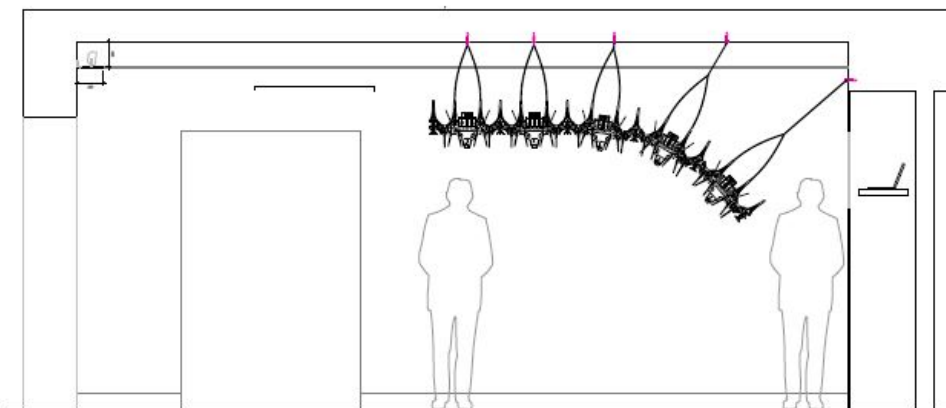


Sentient Veil, Isabella Stewart Gardner Museum, Boston, MA (2017)

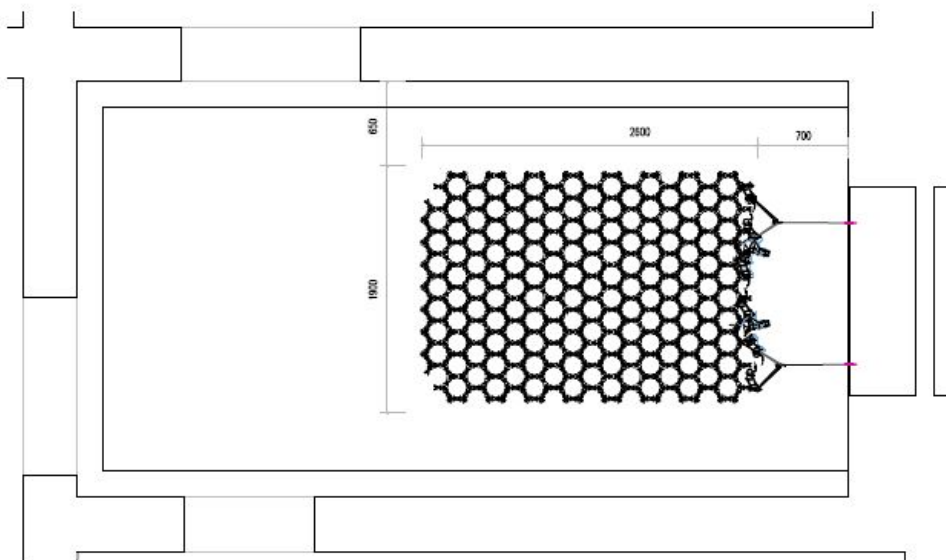




B3 Short Section

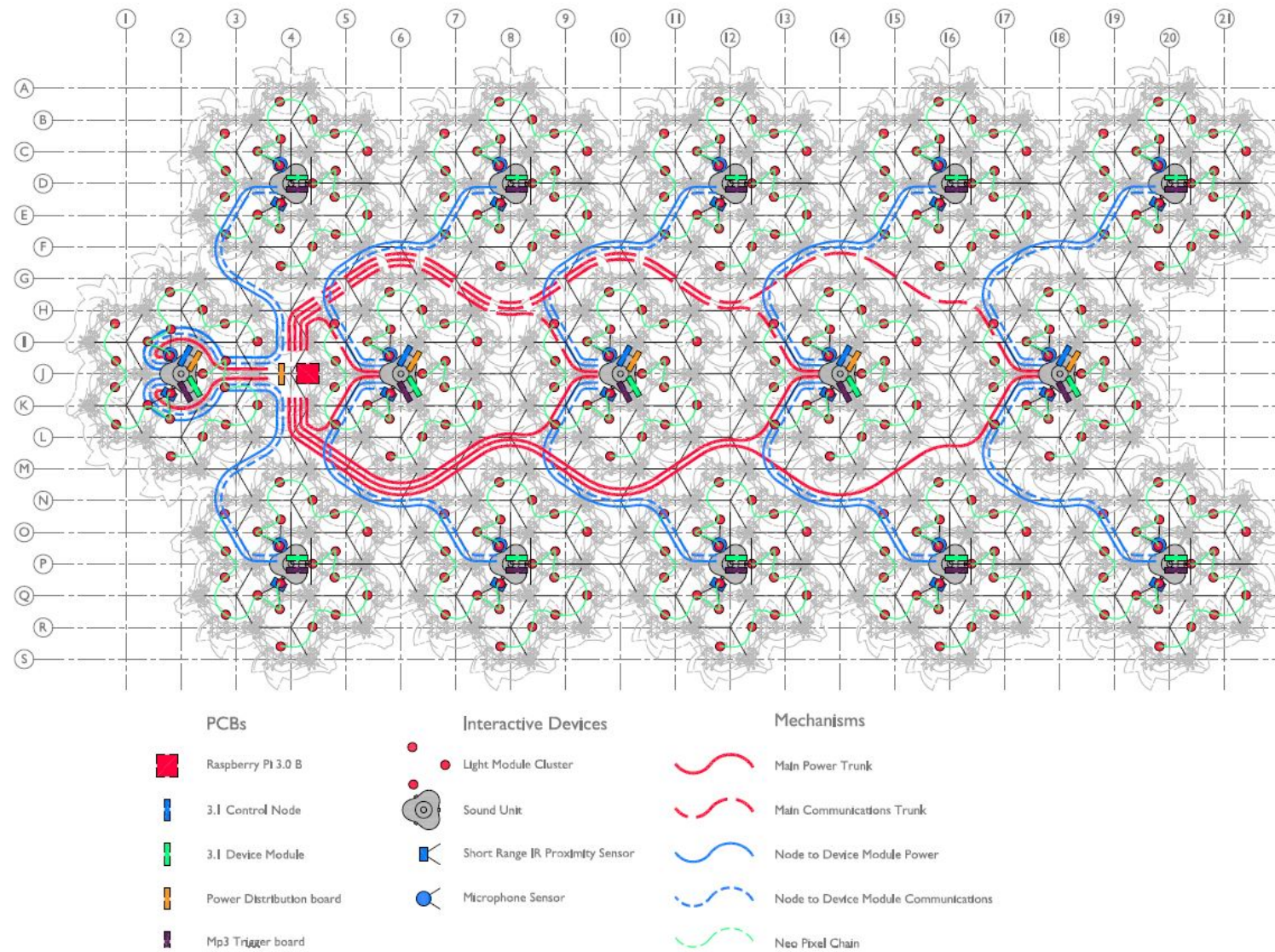


B4 Long Section



Reflected Ceiling Plan





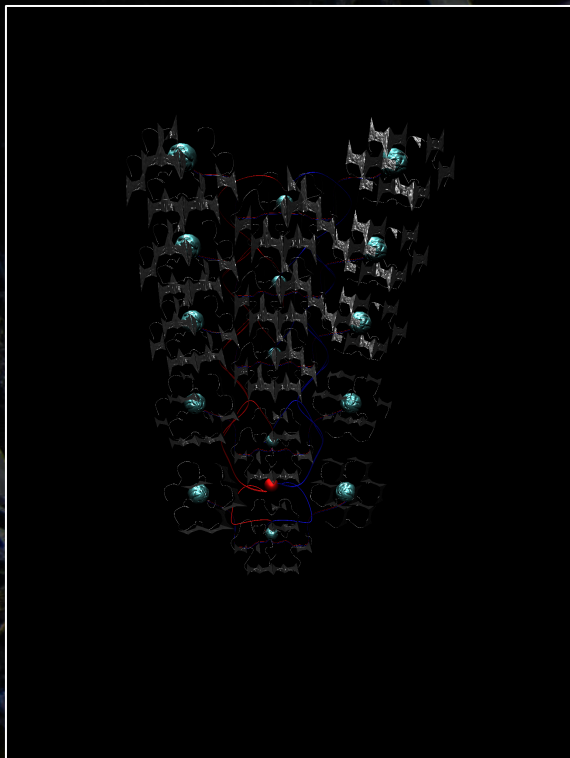




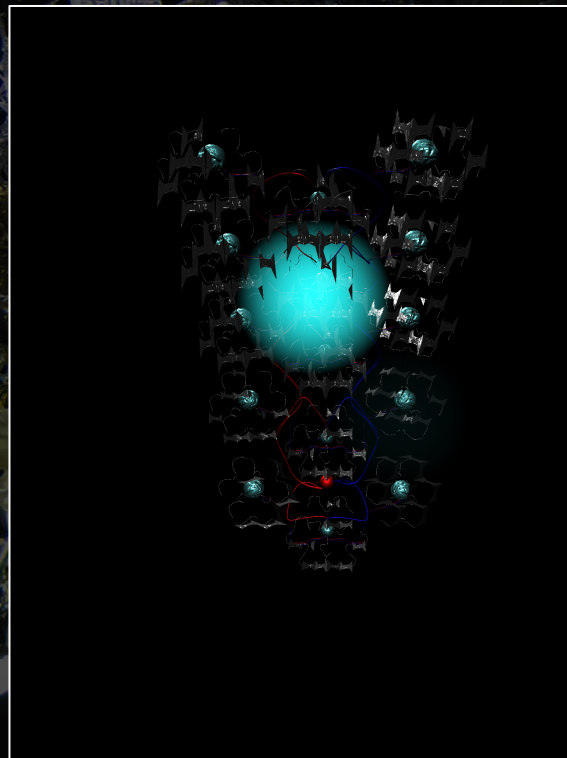
Sentient Veil, Isabella Stewart Gardner Museum, Boston, MA (2017)



# Lifting the Veil App Development



Lifting the Veil Virtual  
0 sensors triggered



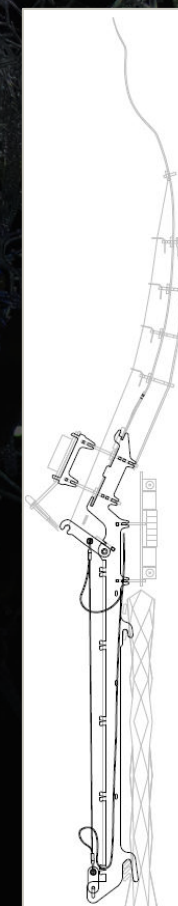
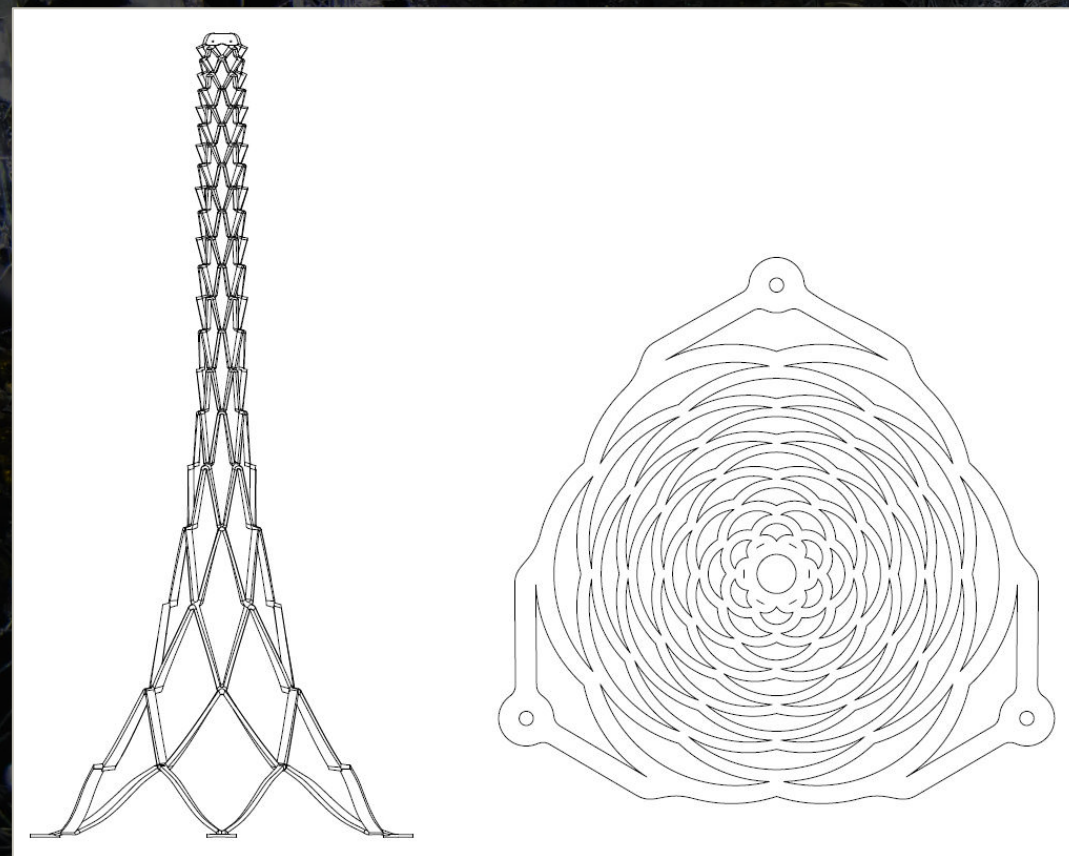
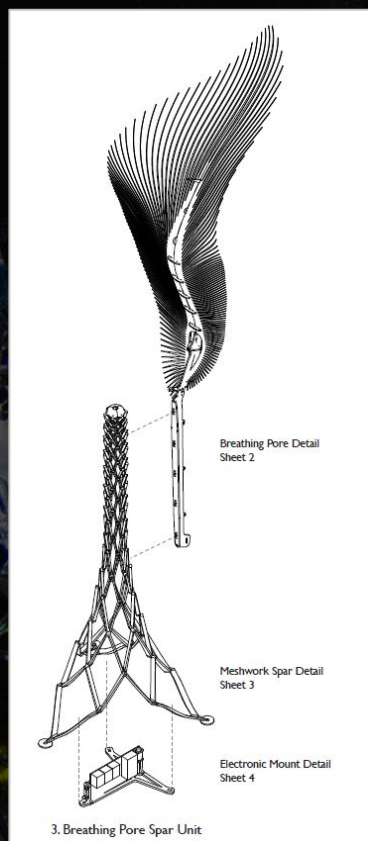
Lifting the Veil Virtual  
1 sensor triggered



Lifting the Veil AR  
2 sensors triggered



# Example project 2: Dendrite



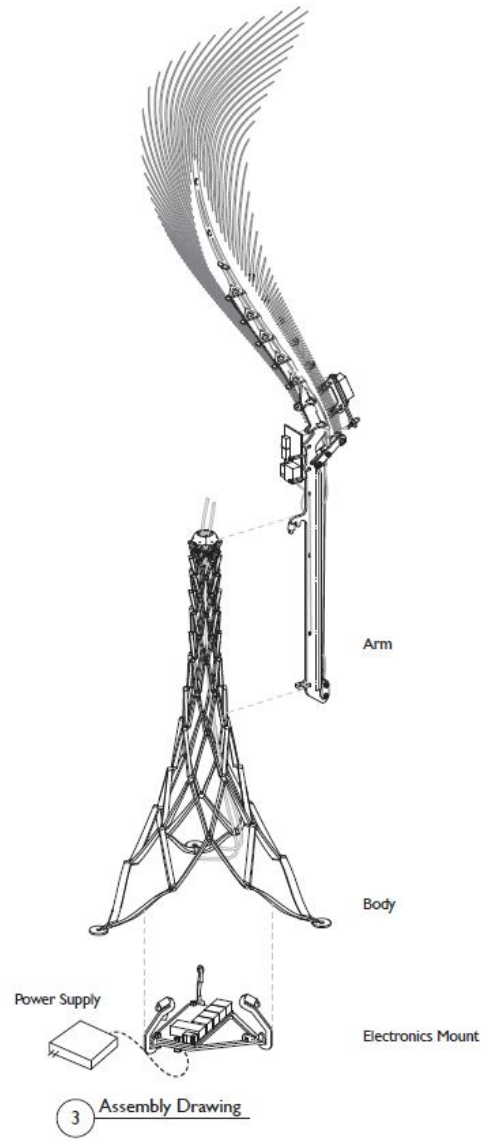




① Dendrite Field: Perspective



② Dendrite Field: Elevation



③ Assembly Drawing

Living Architecture Systems Group

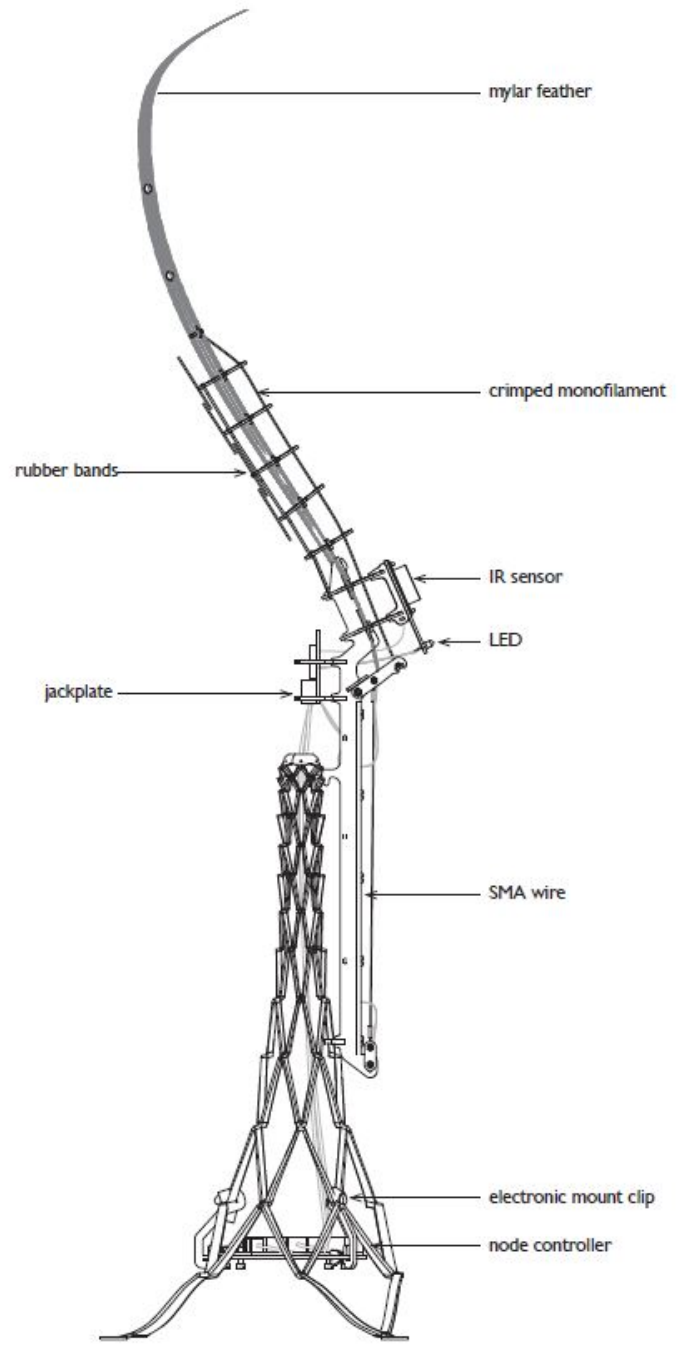
213 Sterlin Road  
Toronto, Canada  
M6R 2B2  
web: lasg.ca  
tel: 416 764 8284  
fax: 416 604 3946

Inc	Date	Status
JP	17/03/29	Preliminary
JJ	17/04/28	Prototype

Notes:

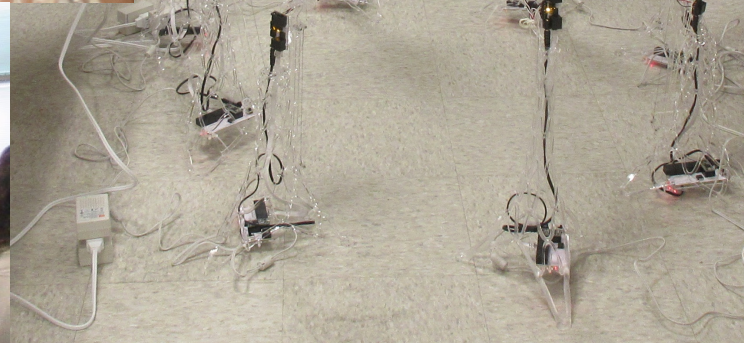
Status:  
Draft for Production  
Project:  
2017 IU Summer Camp: Dendrite  
Drawing Title:  
Grouped Dendrites and General Assembly  
Sheet:  
I-R2





1 Elevation (Side View)









<http://cns.iu.edu/photos.html>



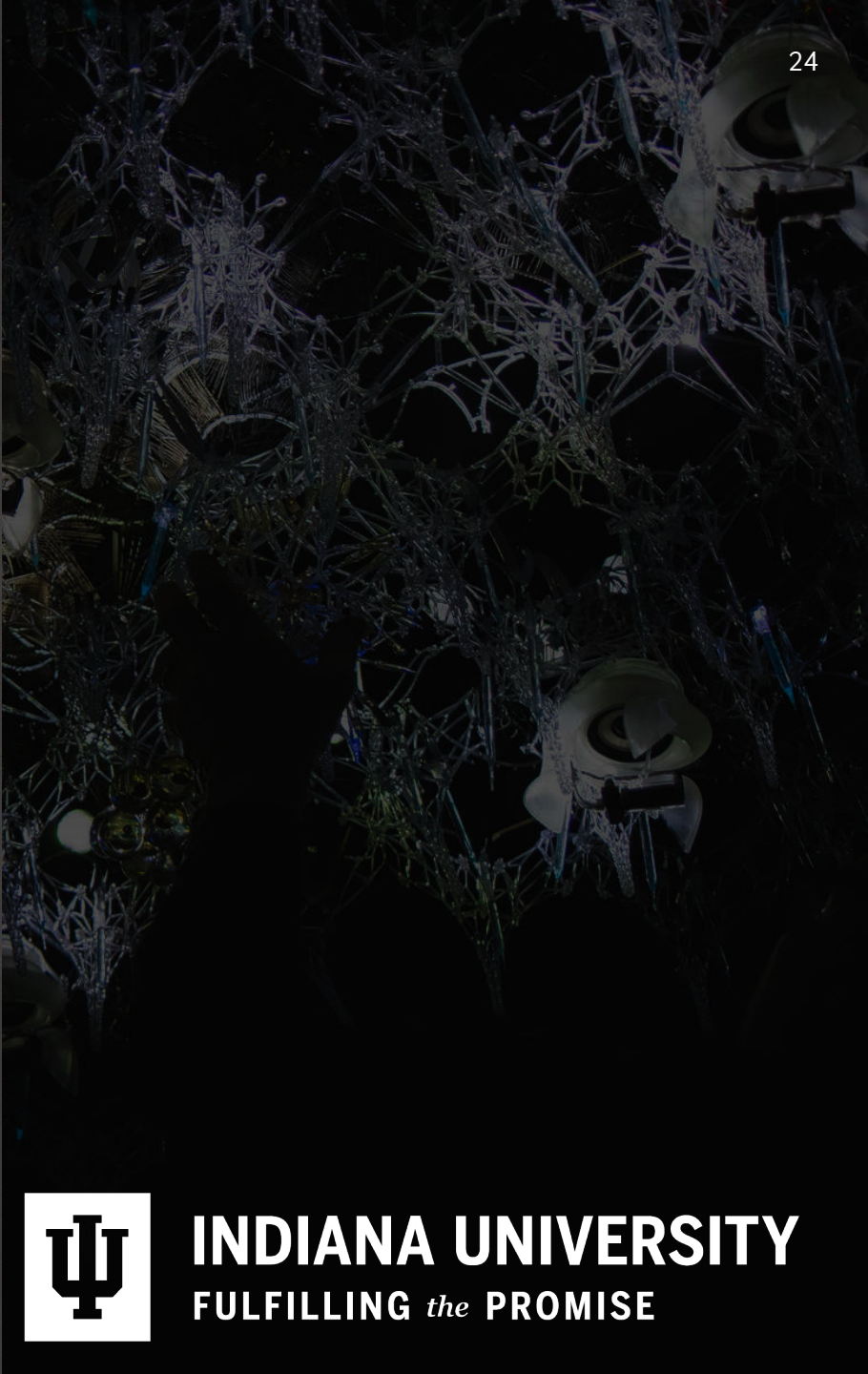
**INDIANA UNIVERSITY**  
FULFILLING *the* PROMISE



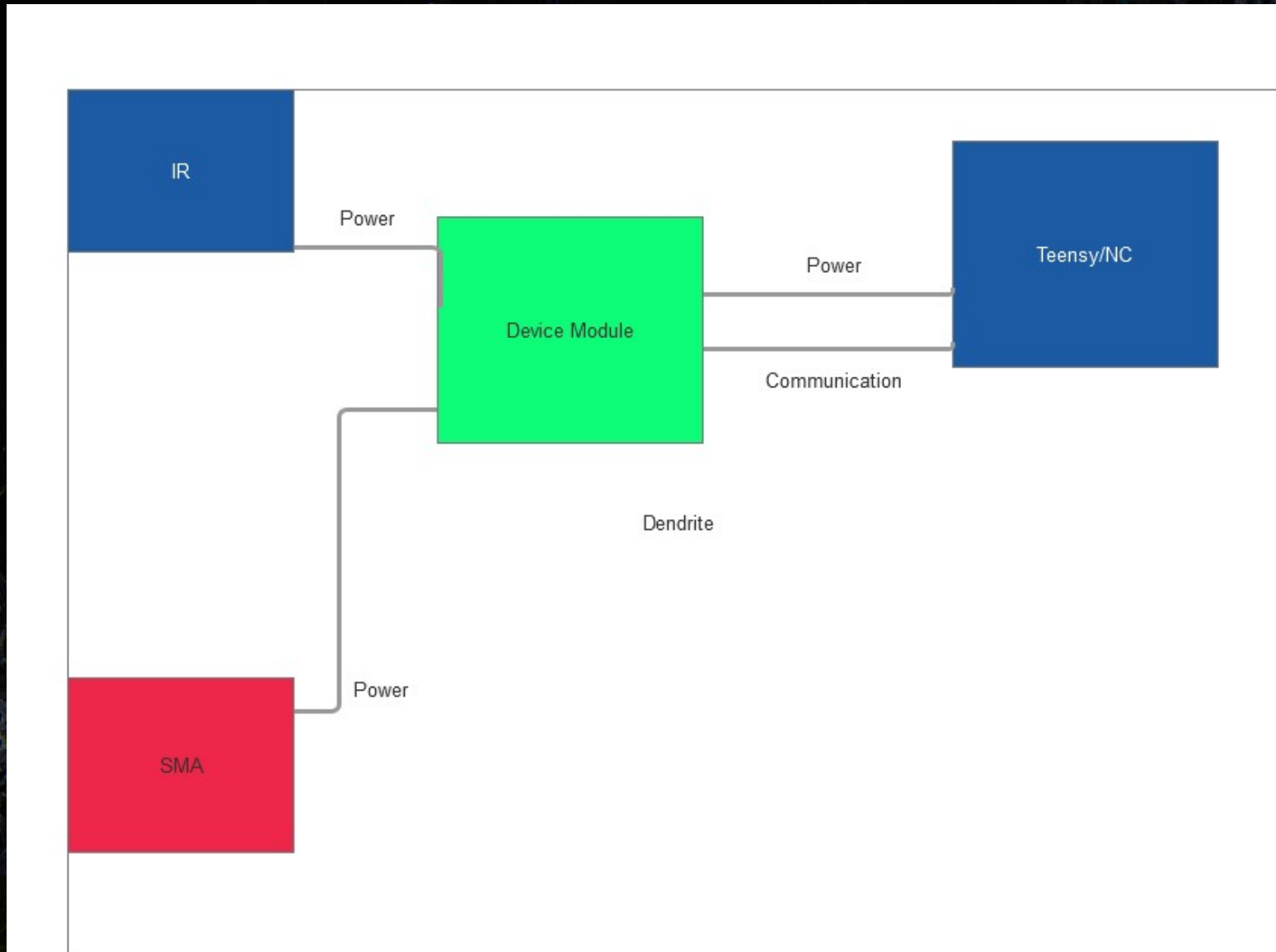
# DEMO TIME!

Meet the Dendrite Desktop Kit





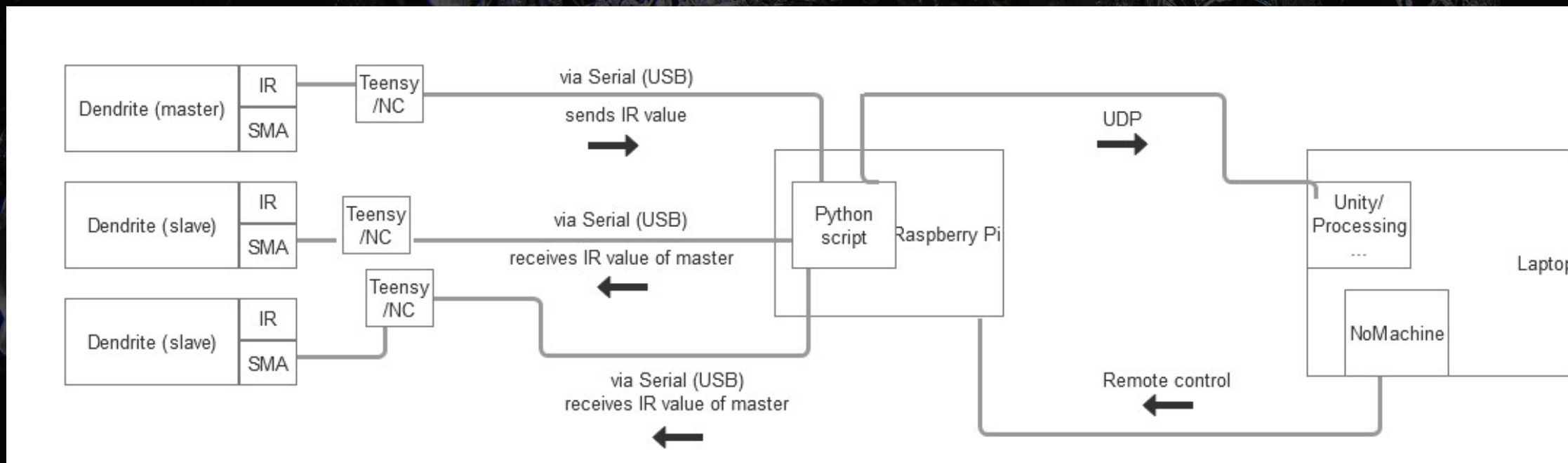




See <https://github.com/pbarch/1714-IU-Summer-Camp> for code



# Dendrite Field Array Schematics



See <https://github.com/andreasbueckle/dendrite-field-array> for code



# OUTLOOK

# I-SIDE

Intelligent Systems Integrated Data  
Ecosystem

*This name is work-in-progress.*



I-SIDE

Bring data, sensors, actuators  
together.



I-SIDE

Enhance IoT.



I-SIDE

Integrate  
Sensors, actuators, smart devices,  
Amazon Alexa...



I-SIDE

Make it an ecosystem.





And visualize it.





# The Team



Philip Beesley



Katy Börner



Matthew Spremulli



Andreas Bueckle

## ▶ Further collaborators and supporters:

- ▶ Living Architecture Systems Group (LASG): Rob Gorbet, Dana Kulic, Adam Francey, Filip Vranes, Reza Nik, Salvador Miranda, Siddhant Chandgadkar
- ▶ IU: Christian Mckay, Gregor von Laszewski, Chauncey Frend (Advanced Visualization Lab)



Questions?



# References (Excerpt)

- ▶ Börner, K. (2015). Atlas of Knowledge: Anyone Can Map.
- ▶ Börner, K. (2016). Data Visualization Literacy. Proceedings of the 27th ACM Conference on Hypertext and Social Media - HT '16, 1-1. <http://doi.org/10.1145/2914586.2914604>
- ▶ Börner, K., & Bueckle, A. (2016). Visualizing Living Architecture: Augmented Reality Visualizations of Sensors, Actuators, and Signal Flows. In White Papers, edited by Beesley, Philip, and Ala Roushan, p. 109-112. Riverside Architectural Press.
- ▶ Börner, K., & Polley, D. E. (2014). Visual insights: A practical guide to making sense of data. MIT Press.
- ▶ Boy, J., Rensink, R. A., Bertini, E., Fekete, J., Boy, J., Rensink, R. A., ... Member, J. F. S. (2015). A Principled Way of Assessing Visualization Literacy To cite this version: A Principled Way of Assessing Visualization Literacy.
- ▶ Herdal, T., & Pedersen, J. G. (n.d.). Designing Information Visualizations for Elite Soccer Children ' s Different Levels of Comprehension.
- ▶ Kwon, B. C., & Lee, B. (2015). A Comparative Evaluation on Online Learning Approaches using Parallel Coordinate Visualization. In 34TH ANNUAL CHI CONFERENCE ON HUMAN FACTORS IN COMPUTING SYSTEMS, CHI 2016 (pp. 993-997). 1515 BROADWAY, NEW YORK, NY 10036-9998 USA: ASSOC COMPUTING MACHINERY. <http://doi.org/10.1145/2858036.2858101>
- ▶ Lee, S., Kim, S., & Kwon, B. C. (2015). VLAT: Development of a Visualization Literacy Assessment Test.
- ▶ Maltese, A., & Balliet, R. N. (2015). Investigating aspects of data visualization literacy using 20 information visualizations and 273 science museum visitors. <http://doi.org/10.1177/1473871615594652>



# Image Sources

All pictures from the one of the following sources unless marked otherwise:

- ▶ Sentient Veil, 2017, Isabella Stewart Gardner Museum, Boston, MA. Photography by Andreas Bueckle
- ▶ Sentient Chamber, 2016, National Academy of Science, Washington, D.C. Photography by Andreas Bueckle
- ▶ Dendrite Schematic Drawings, Philip Beesley Architect Inc., Toronto, ON (Canada)
- ▶ Sentient Veil Schematic Drawings, Philip Beesley Architect Inc., Toronto, ON (Canada)
- ▶ Andreas Bueckle, XRAY App, Misc.
- ▶ Philip Beesley Architect Inc., Misc.
- ▶ [https://media.licdn.com/mpr/mpr/shrinknp\\_200\\_200/AEAAQAAAAAAAAA1\\_AAAAJDFIMzIzMThhLWIyOTMtNGJhNy04NThjLWY5N2VhN2FmNmFiMw.jpg](https://media.licdn.com/mpr/mpr/shrinknp_200_200/AEAAQAAAAAAAAA1_AAAAJDFIMzIzMThhLWIyOTMtNGJhNy04NThjLWY5N2VhN2FmNmFiMw.jpg) (photo of Matthew Spreulli)