Værbitt: A Responsive Weather-Protective Envelope for Bergen City Hall

When I think about architecture, I think of it as a piece of clothing that must be wrapped around human beings*

* Toyo Ito, Interview, 2014. *https://vimeo.com/102222950*

Context

Contemporary architecture is being transformed by developments in interaction research, mobile connectivity, open-source design, algorithms, and CNC manufacturing. These emerging technologies reshape our understanding of space and the way we relate to each other. These conditions allow architecture to become be dynamic, conversant, emotive, and responsive, instead of static. Much of these developments are driven by non-architects. However, architects can contribute to the discussion because their expertise lies in the formation of spatial and environmental situations, and can thus provide hints to approaches towards creating spatial poetry within these new developments.

Motive

This project is developed within the framework of Responsive Architecture. An evolving field of architectural practice and research dealing with the design of buildings or elements that react to specific environmental conditions or user's needs. There are two critical components in responsive designs; the sensors and actuators. The sensors measure actual conditions such as sound, light, temperature, humidity, movement, position or speed. According to the data measured by the sensors, the responsive element reacts by changing its shape, colour, position or any other property thanks to the actuator. The result is an adaptable architecture that responds to different environmental and programmatic conditions. This project is a work in progress, a research process that explores the potential of the evolving field of responsive kinetic architecture.

The project has two phases, an initial research phase, exploring different modes of responsive technologies and media, such as responsive drawing and mapping. Followed by a case study, which aims to develop a spatial prototype.

Sustainability

If a significant change in energy consumption trends is to be implemented, there must also be consideration of the existing building stock. It is essential to consider not only low-energy strategies for new buildings, but also how energy saving strategies can be applied to existing buildings in refurbishment. The incorporation of intelligent technologies does not have to be confined to new building design. By utilizing the building fabric itself (the 'skin'), artificial heating, cooling, lighting, and other energy importing systems can be minimized, or avoided altogether. Ideally, a building is a power station in its own right. Furthermore, solutions to concerve building mass as long as possible should be encouraged. As the cost of demolition and rebuilding exceeds what our environment can take.

Approach

A responsive kinetic envelope can address multiple problems or aspects of a building. It can provide thermal control and insulation, airflow through ventilation, most importantly, protecting natural concrete façade against harsh weather. When the weather is challenging and humid, the envelope can close; when it is warm and dry, it can open up to let the concrete breathe. This new skin/envelope performs like a raincoat or umbrella. Furthermore, in response to local weather conditions by opening and closing in different degrees, the natural concrete façade, is showcased in a play of revealing and concealing.

Case Study

As a case study for the research, I've chosen to work with Bergen city hall. Erling Viksjø designed the building. Like his high-rise block in the government quarter in Oslo, the city hall in Bergen is built of natural concrete, concrete with river gravel, which is sandblasted to bring out the natural stone; this gives the building a unique material quality and cultural heritage value. In 2012, maintenance discovered that the façade was suffering from concrete disease, which occurs when cracks form so that water penetrates the reinforcing steel in the wall. The steel corrodes and swells, and the concrete begins to dissolve. Ongoing rehabilitation of the town hall, which will extend the building's life by 50 years, will unfortunately alter the building's unique material qualities.

Tutors

DAV: Charlotte Erckrath

APP: Cristan Stefanescu
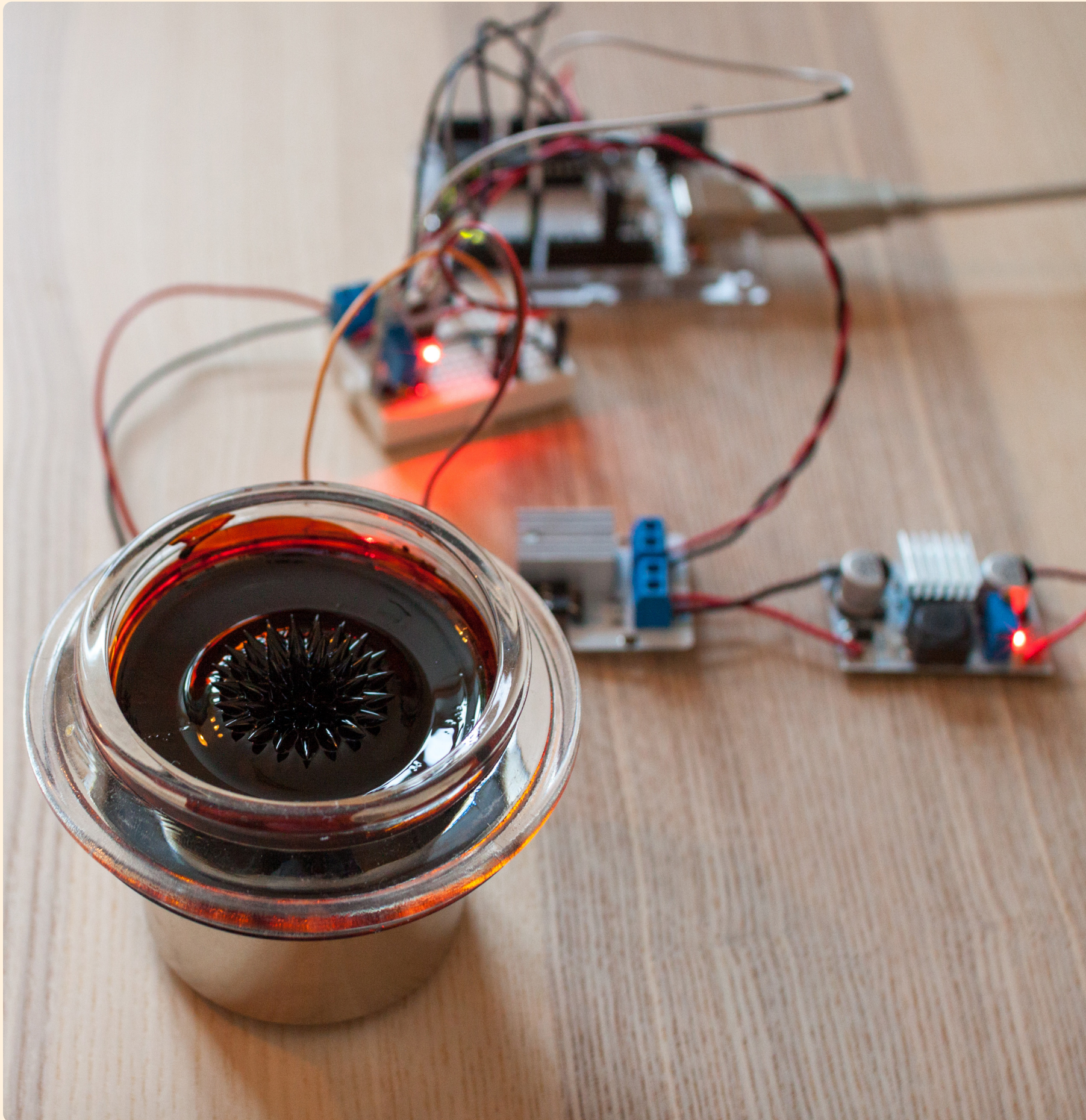
Fig. 01 *Initial concept model/prototype. From parts I had lying around, I was able to build a sound controlled electromagnet. The way it works is that the sound sensor picks up the sound, a signal is then sent to the microcontroller, which is programmed to send signals that alter the power of the connected electromagnet. The magnetic field being invisible to our senses is visualised with the aid of ferrofluid. Replacing the 'input' and 'output' offers rich potentials.*

References

Tools

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— **vvvv [www.***vvvv***.org]**

— **SuperCollider [www.***supercollider***.sourceforge.net]**

— **ThreeJS [www.***github***.com/mrdoob/three.js]**

— **Pure Data [www.***puredata***.info]**

— **PaperJS [www.***paperjs***.org]**

— **NodeBox [www.***nodebox***.net]**

— **Polycode [www.***polycode***.org]**

— **d3JS [www.***mbostock***.github.com/d3]**

— **RaphaelJS [www.***raphaeljs***.com]**

— **GitHub [www.***github***.com]**

— **Arduino [www.***arduino***.cc]**

— **Grasshopper3D [www.***grasshopper***3d.com]**

— **Rhinoceros3D [https://www.***rhino***3d.com]**

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Curriculum Vitae

Personalia	**Soheil Hivad Nabi**	
	Born October 21st, 1989 in Bodø, Norway.	
Education	**Bergen School of Architecture**	
	M. Arch, 2013-2021	
	University of Oslo	
	Art history, Fall 2012	
	Noroff School of Technology and Digital Media	
	Technical Design with 2D/3D, 2011-12	
	Einar Granum School of Fine Art	
	Visual Arts and Model design, 2009-11	
Work	**KODA arkitekter AS**	
	CAD Operator / BIM Specialist, 2012-13	
Interests	*Computers*	
	Programming	
	Electronics	
	Photography	
	Computer numerical control	
	Cinnamon rolls	

Master Courses

Moving Through, Spring 2020
Through a series of dynamic canopies responding to local acoustic conditions, the project engages into a very personal and commonly important concern in searching for an acoustic and visual shelter within a site of high exposure to noise and traffic. The research revolved around developing the drawing tools to map and simulate the acoustic experience to use as a design tool, which also allowed for altering the acoustic experience on the site revealing the potentials for acoustic interventions.

Complex Context, Autumn 2017
Connecting the Disconnected opened a discussion of how the campus at Kronstad in Bergen could give a missing urbanity to the place. The process of the project also explored how a building could become a building with an urban compromise. The program idea included a coherent and intense negotiation with the site programs, trying to build creative tensions by reacting to the existing program segregation. The project elements build a corresponding exterior public space, creating a strong negotiation between inside and outside space.

5050, Autumn 2016
A Utopian Approach is a project that shows a future use of the Y-block in the Government Quarter in Oslo. It presents the area adapted for the public with openness as a cornerstone, as an alternative to establishing strict physical security measures. In this way, the project seeks to regain some of Erling Viksjø's architecture's original qualities. The proposals include removing new elements added to the area, e.g. The "lid" over Arne Garborg's square, to open up for movement between the square in front of the H-block and Arne Garborg's square. An essential public element in the project is an auditorium that is inscribed over two floors.