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# Tokyo in(di)visible

## Descodificando el aire urbano a través de la programación de ambientes inmersivos

### Resumen

El aire, entendido como la plataforma común para todos los seres humanos, substancia material cuyo status y resolución es típicamente ilegible y que en la actualidad ha llegado formar una barrera capaz de dividir el espacio urbano, y que a diferencia de lo estático e impermeable, puede ser penetrado y manipulado, puede ser, activa e iterativamente diseñado. Mediante el uso de herramientas computacionales, sensores y actuadores, se propone una red de prototipos como infraestructura urbana temporal - un espacio exterior poroso, definido en función de la evolución de las condiciones ambientales dadas, acentuando la experiencia en el entorno exterior y filtrando las partículas en el aire como resultado final.

Tokio in(di)visible formula la hipótesis de hacer actuales las percepciones del espacio definido bajo los términos opuestos de interior / exterior y preciso / incontrolable llevado a cabo mediante tres fases sucesivas, Descodificando el Aire Urbano, Artefactos Urbanos Sensitivos y Programación de Ambientes Inmersivos. A través de una red de artefactos sensibles la arquitectura se sitúa entre lo natural y lo artificial mediando el cuerpo humano, lo social, la ecología y la tecnología dentro de la condición urbana.



**Palabras claves:** tecnología, prototipo, sensible, social, ecología

# Tokyo in(di)visible

## Decoding urban air via computing immersive environments

### Abstract

*'…man is not only what he eats, but what he breathes and that in which he is immersed.'–Peter Sloterdijk*[1]

Air is the common platform for all humans—a defining material substance whose status and resolution is typically illegible and has come to be, along with the 'hard surfaces' of the city, another boundary capable of dividing people. However, unlike the static and impermeable, air can be penetrated and manipulated, and can therefore be iteratively designed. Varying in qualities such as temperature, humidity, and pollution, the description of air is specific to each location. By using computational tools, sensors, and actuators, a networked field of architectural prototypes is proposed as a temporary urban infrastructure—a porous exterior space that is defined as a function of the evolving environmental conditions in which it is situated, enhancing the experience of the outdoors and removing airborne particles as a by-product.

Tokyo In(di)visible hypothesizes to make current the perceptions of space as defined under opposing terms of interior/exterior and precise/uncontrollable, and is conducted in three successive phases, Decoding Urban Air, Sentient Urban Artifacts, and Computing Immersive Environments. Through a networked field of sentient artifacts, the architecture situates itself between the natural and artificial—mediating the human body, the social, ecology, and technology within the urban condition.

**Key words:** technology, prototypes, sensing, social, ecology

[1] Sloterdijk, Peter, Amy Patton, and Steve Corcoran. Terror From the Air. Los Angeles: Semiotext(e), 2009.

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## Decoding urban air via computing immersive environments

**Hashtag:** #technology #prototype #sentient #social #ecology #arduino #urban #blackbox #Tokyo #air #pollen #decoding #vision #communication #hanami #hayfever #feedback #dynamic #architecture.

## I. Introduction

Cities have become increasingly dynamic, both in terms of the activities that they host and the environments in which they are situated. With more than half of the world's population now living in urban contexts, the accumulated effects of individuals, the environment, as well as the number of people affected has been amplified. However, such complexities are impossible to track manually, and society has turned to data mining and computational tools to process the effects. Yet, despite the vast array of sensors and information being constantly collected through data mining, data typically seems to flow in one direction, meaning it is simply compiled and is often finalized in a form of representation, such as a map or graph. The following research questions these limits on the use of data, first on how it is created and collected, second on how it is communicated, and finally, on how it can actually be materialized and used.



Recent environmental issues have been made evident by their visible impact on their surroundings, such as excessive pollution, which literally casts a cloudy haze over entire cities. Some others, however, are more subtle or gradual in their effects, such as the cumulative pollution caused by a single car's journey throughout the day. While these changes physically impact the urban landscape and infrastructures, unless in excess, they are often invisible to the naked eye or disappear altogether, as roads, sidewalks and buildings are perpetually being rebuilt, refurbished, and often designed to resist the dynamic forces acting upon them, causing a disconnect between how the city *actually* is and how it is *perceived*. Can architecture, one of the major constituents of the city's fabric, while serving as a function of space and social interaction, also be used as an active tool for reading, communicating, and modifying the perpetually evolving conditions in which it is situated?

The schism between the reality and the perception of the urban environment can be attributed to what Bruno Latour refers to as 'black boxing,' by which the success of a technology causes it to be no longer thought of as made up of its parts with a specific function, but instead as a single entity, rendering it in many ways invisible to the user. Domínguez and Fogué elaborate on this notion, specifically within the urban context, wherein the city's water and waste systems, communication networks, and energy and industrial infrastructures are either buried underground or have slowly been displaced to the peripheries of the city (Domínguez, Fogué 2013). Equally important they note, however, is the way in which nature has been integrated into urban centers as carefully domesticated environments, which brings to question the common understanding of how nature works; what is classified as manmade, and what is classified as natural? While such changes in the handling of certain infrastructures and select nature have undoubtedly made cities more liveable, the hiding of very real flows and effects has fundamentally altered the ways in which people interpret their surroundings as well as the awareness of the impact of collective actions.

The research's aim is twofold. First, it seeks to open the black box of the city's air, a generally invisible, dynamic, and increasingly highly politicized substance, and second, to make the information flow bi-directionally, whereby information is perpetually read and acted upon, exploiting its potential to be fed back into the loop as part of a generative input/output loop, thus having the potential to fundamentally alter the trajectory of the evolving urban cycle.

As such, the research was conducted in two successive phases:

- *Decoding Urban Air*; a means for retrieving local air data and wind behavior.
- *Sentient Urban Artifacts*; a series of architectural prototypes physically shaped according to the data, while also sensing and actuating in response to real time changes.

The following research acknowledges the complexities of the contemporary city, ecology, society, and economy, and hypothesizes how data can be used not just as an analytical tool bound as a form of representation, but as something that escapes the screen and can be made tangible, perceptible, and as is sought to be demonstrated in the following sections, tuned to an aesthetic sensibility (Fig 1).


Fig.1. Final Prototype (2.4 x 2.4 x 2.4 m). Right; Overall proposal. Left; Detail of Transparencies.



**II. Background**

*'Humans are not only what they eat, but what they breathe and that in which they are immersed'. (Sloterdijk, 2009).*

Air as a Material

Air was first weaponized in the form of chlorine gas during World War I (Latour 2006) (Fig.2a), after which it has continuously been perceived as a potential risk to one's health. As the transporter of airborne pollutants and diseases, unless present in excessive quantities, air is generally understood to be invisible, unpredictable, undetectable, and therefore uncontrollable. The introduction of air conditioning systems (Fig.2b) has perpetuated the perceived difference between interior and exterior air, bringing about the dominant use of interior spaces which are conveyed as pure and clean volumes of air protected from the exterior surroundings (Fig.2c). Paradoxically, it has been shown that in many cases interior spaces are in fact environments for promoting the growth of certain respirable bacterias as well as being containers for decaying materials within buildings themselves, resulting in what has been termed *sick building syndrome* (Murphy 2006).
The ability for air to divide territories has become increasingly evident in recent years, where the perception

of what denotes a border has become blurred and challenged by its capacity to transcend and redefine new forms of boundaries (Ratti 2008). The relevance of the topic prompted investigations into different forms of using air in architecture. In highly polluted contexts, pollutants and dust can become a source for cladding a building, which in turn also serve to demonstrate the high contrast of interior and exterior environments (Roche 2002). Conversely, in its invisible state, air can trigger non-visual sensorial experiences through changes in pressure and temperature as part of a corporeal engagement (Rahm 2008). When visualized in the form of an amorphous cloud, traditional forms of human recognition through seeing are blurred, prompting new forms of social interaction (Diller 2002). Finally, using the existing cityscape and a virtual overlay, a real-time map can be generated, allowing viewers to visualize current air conditions, thus empowering them through being made conscious (Calvillo 2008).

The above models demonstrate different ways by which air can be used or visualized in informing sensation, building, interaction, or action. The current research presented seeks to form a coherent project that evolves the dialogue with an architecture that can mediate the contemporary complexities of the human body, and the society, economy, ecology, and technology within the urban condition. Furthermore, the project aims to actively participate, inform, and eventually modify the status of the city's air.

Case Study: Tokyo, Japan

Tokyo is examined as a modern-day case study, two contradictory events occur simultaneously each year—an outdoor social gathering known as *hanami* (flower viewing), and an extreme increase in amounts of airborne pollen, which causes hay fever, known in Japanese as *kafunsho*. The two issues were extensively researched, revealing the intricacies of both annual recurrences, which ultimately informed an architectural response unique to its circumstances (Fig. 2c, d, e).




Fig.2. Air as a tangible material. (A) Technical illustration of gas masks used during WW I, ca 1916. (Latour 2006). (B) "Air Conditioning Room" at Harvard School (Murphy 2006). (C) Pollen cloud being released from a cedar tree (Japantimes 2014). (D) Tokyoites wearing masks. (Quora 2016). (E) Tokyoites wearing masks to prevent hay fever symptoms during cherry blossom (Masks and Sakura 2017).

Pollendystopia: A History of Tokyo's Manmade Natural Pollution

In Japan, the end of the Second World War saw what is largely considered an unparalleled re-construction effort. In Tokyo alone, where 160 square kilometers were burned by more than 100 fire bombings, the Japanese government ordered a large number of Japanese cedar trees to be planted directly outside the metropolitan area. 20,000 square kilometers of diversified forest were felled and supplanted with Japanese cedar trees, or sugi in Japanese (Cheng, McBride 2013).

While the newly planted trees were still too young to be used, the economy began growing at an unanticipated rate, which created an unforeseen demand for housing and resulted in the depletion of local timber supplies. In 1960, the strict importation laws were liberated and allowed foreign timber to enter the market at a far cheaper rate, which has since caused the Japanese wood self-sufficiency rate to greatly decrease from 86.7% to 19.2% in 1999 (Japan's Timber Trade and Forestry). Today, the now matured 4.6 billion cedar trees are the source of unprecedented amounts of spring pollen (Fig.2c) and consequently pollinosis, commonly known as hay fever, or kafunsho in Japan (Fig.2d).

The annual spring epidemic causes severe reactions to 1 in 4 Tokyo residents, and can be understood as a form of man-made natural pollution (Otake 2017). The government has deemed that the only way to reduce the amount of pollen in the air is to reduce the number of pollen-producing trees, however, with the value of timber at an all-time low, and the trees privately owned, tree owners are reluctant to sell.

With the prevailing presence of pollen, hay fever sufferers have been able to take matters into their own hands by using anti-histamines, committing to long-term hypo-sensitization therapy, or wearing special eye protection and masks, which in turn generate their own by-products: financial burden, or anti-social behavior—breeding with it a new economy. In 2006, an estimated 20 billion yen a year (177 million USD) was spent on treatment of this cedar-pollen allergy (Nicol 2006).

Today, there is an annual forest growth rate of 70 million cubic meters while timber consumption is at a low 19 million cubic meters (Japan's Timber Trade and Forestry), making the chances of hay fever being reduced by the current economic model unlikely. Moreover, with the total amount of pollen doubling from last year, current forecasts predict that the amount of people affected will reach 30% before 2020.

Hanami: The Production of Public Space

"Hanami takes place at the only public space in japan...lasting only as long as people choose to gather." (Ohnuki-Tierney 2015)

The flower viewing of the cherry blossoms, known as hanami, as described by Ohnuki-Tierney exemplifies the difference between a space that is contained as a static moment, and a space that is formed through temporal action, through the presence of people, and in that sense necessarily adaptable and ephemeral. It is the only time in the year where the exterior space is informally conquered by people in order to gather, socialize, and celebrate the viewing of the cherry blossoms, which in itself contains social, historical, and political meanings.

Historically, the celebration of the "flower viewing" (花見) materializes the collective identity through the sentiments of belonging to Japanese society. Although the tradition of flower viewing was initially adopted from China, feelings of Japanese self-identity prompted the switch to the native sakura (cherry blossoms), around which an entire aesthetic and tradition would be formed. The increased numbers of sakura would eventually lead Japan to being referred to as the land of the cherry blossoms (Ohnuki-Tierney 2004).



From a more recent perspective, today's hanami celebration is the democratization of public space. Previously, the sakura viewing was reserved for the elite of the imperial courts and aristocrats, and was therefore not a practice afforded to the general public. However, an initiative was formed to plant the sakura in common outdoor areas, allowing the tradition to spread and become part of the greater public.

The space created around the practice of cherry blossoms inherits certain qualities that enhance it as an ephemeral non-normative space; where certain established norms have been challenged through the anesthetizing of cherry blossoms. For instance, the utilization of mask and masquerades in traditional hanami celebration allows oneself to be presented as a foreigner and challenge the notion of self-identity. Hanami's celebration therefore cannot be seen as a simple gathering outside; it constitutes in itself the common identity of the Japanese national collective, challenging different boundaries, first from a historical perspective through the creation of a national identity, second from an urban perspective through the democratization of the production of public space, and finally from a social perspective, through the aestheticizing of non-normative realities.

The consequence of these overlapping events results in a contemporary conflict, where under the flowering cherry blossoms and exposed to the pollen filled-air, exterior spaces become zones of contradiction, and therefore divided (Fig.2e).

## III. Methodology

The research hypothesizes that the aforementioned complexities can be utilized to visualize, communicate, and create a space, synthesizing the various issues into a unique architectural response; in this case specifically, the overlapping events of hanami and kafunsho (cherry blossom viewing and hay fever).

Part 1: Decoding Urban Air

Airborne particles are primarily influenced by wind flow, necessitating the retrieval of wind data from a given site. However, rather than generating the wind data purely from simulation software, it was speculated that such data could be retrieved through examining the existing site in a particular way; using the field of vision in a way that Paul Virilio compares to a ground for archeological excavation (Virilio, Degener 2005). It was found that real trees actively respond and shape themselves according to wind over time in a process known as thigmomorphogenesis; plants respond to wind and other mechanical perturbations in a way that is favorable to the plant for continued survival in windy environments (Telewski, Jaffe 1986) (Fig.3a, b).

While in some extreme cases prevailing wind forces and directions are evident, in most instances the differences are not visible to the naked and untrained eye. Therefore, we propose a system of hybrid computer/human vision in a process referred to here as Reverse Algorithmic Thigmomorphogenesis, developed using Rhinoceros and Grasshopper. Whereas computational vision excels at quantitative evaluation, such as two- and three-dimensional measurements, human vision is intuitively tuned to detect and differentiate between qualitative attributes, such as instances when a branch has been trimmed or the stem has rot. The following describes how the Reverse Algorithmic Thigmomorphogenesis process works utilizing both forms of vision (Fig.3c):

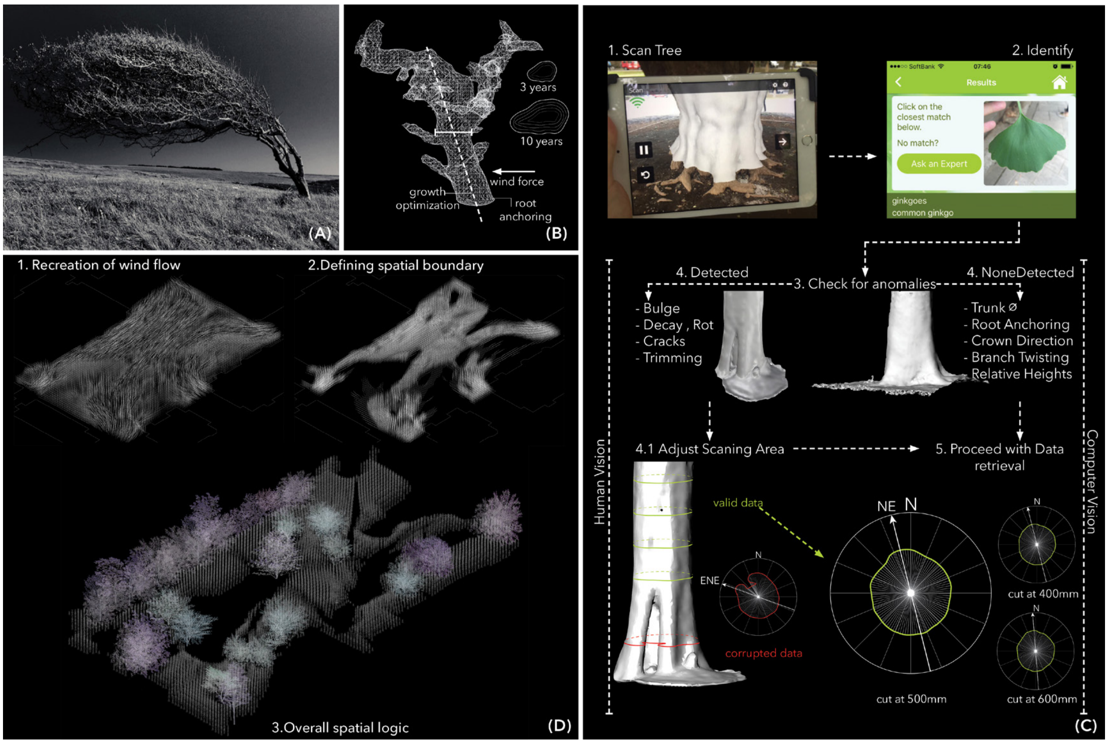




Fig.3. Decoding Urban Air. (A) Wind Shaped Tree. (B) 3D scanned tree and deformation diagram. (C) Reverse Algorithmic Thigmomorphogenesis diagram. (D) Spatial Logic.

The first step is to scan the existing trees through iSense 3D Scanner, thereby 3-dimensionalizing them. Next, the tree types must be identified to understand their phenotypical properties and tendencies. The third step is to check for anomalies which risk distorting the data, such as buttress rotting, bark cracking, or even human interference such as pruning and trimming. If no anomalies are detected, the measuring proceeds as normal, determining the crown direction, branching deviations, trunk diameter, root buttressing, and relative height compared to others of the same type. If anomalies are detected, however, areas to exclude from the calculation must be identified, and new areas for calculation determined. After the adjustments have been made, the calculations can resume and the data extracted, which is then used in the CFD analysis to both evaluate and compare results.

A beta version of the proposed system was tested on a selected site (Engineering Building 1, UTokyo). The trees around the perimeter were identified as predominantly gingko, whereas the trees within the perimeter were much smaller and of various types. For our purposes, these were treated as sakura. In this case, the wind data was retrieved from scanning and decoding the stem and root buttress, where the trees were serially sectioned, measured and averaged in order to determine average wind directions at their locations. Five predominant directions were determined, which when compared against the data of the Japanese Meteorological Agency, proved to be accurate within an acceptable tolerance.

This information was then input into Flow Designer (a Computational Fluid Dynamics software, or CFD) where a three-dimensional model of the site was used to generate the local wind patterns with respects to the different predominant wind flows.

To determine the overall arrangement and placement of Artificial Trees (explained further in Part II) as an integrated part of the existing site, a logic was devised with respects to the context of pre-existing trees and wind patterns.

The extent of the boundary was defined by overlaying the wind simulations from the 5 predominant directions and removing the vectors which were below a certain threshold. The vectors which conflicted within a buffer zone proportional to the tree size were also removed (Fig.3d).

Lastly, the rigidity of the grid was+ broken by an attraction of the artificial trees to the sakura, thus creating a denser enclosure around them while forming emerging thoroughfares in the plan.

Part II – Sentient Urban Artifacts

Having understood the correlation between wind and trees, an architectural response appropriate for the manipulation and enhancement of exterior spaces was formalized—referred to in the research as Artificial Trees.

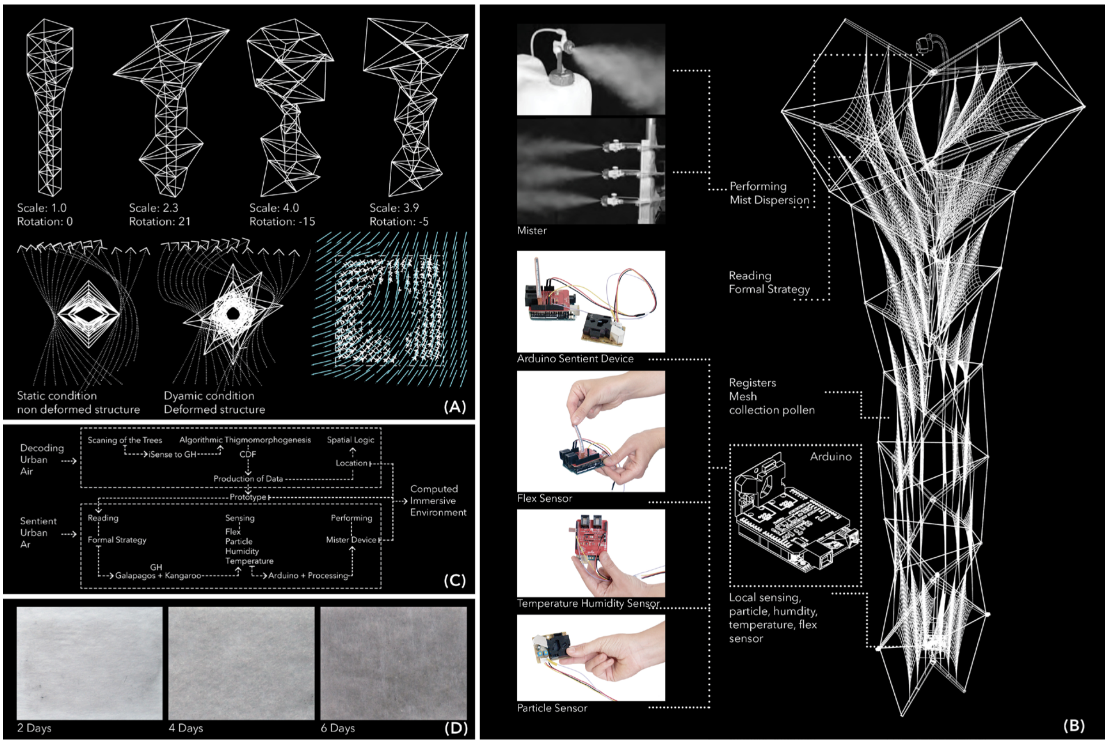


Fig.4. Sentient Urban Artifiact (Artificial Tree). (A) Differential Transformations. (B) Sentient system and artificial tree. (C) Differential transformation and sentient system diagram. (D) Mesh coloration over time.

The Urban Artifact is composed of four key components: a formal strategy, mesh, a sentient system, and an actuating system:

i. Formal Strategy: Differential Growth Algorithm.
The formal strategy of the artificial trees was developed along the analogy of the growth of real trees in response to wind as a series of differentiated transformations. At the individual level, the trees are materialized as a component based tensegrity structure based on the bi-dimensional models developed by Kenneth Snelson in 1948 (Hearney and Snelson) which were later reinterpreted three dimensionally (Frumar et. All

2009). Each of the tensegrity structures undergoes an algorithmic optimization process developed through Rhinoceros, Grasshopper and Galapagos, whereby their exact locations determine the amount of wind loading they can endure, thus affecting the rotation of each component as well as its scale (Fig.4a).

At the collective level, as the larger structures are prone to higher loads and bending stresses, they are interconnected, which reduces the overall stress on single members.

ii. Mesh
The mesh is designed to filter out the maximum amount of airborne particles while simultaneously allowing the exterior conditions through, which is analogous to the way fish gills extract oxygen by flowing water through. The mesh placement and geometry, while performative, maintains a degree of physical and visual transparency, creating multiple layers and the least amount of wind obstruction.

Several commercial mesh types were tested (ranging from fabrics to agricultural applications). Their capacities for water and particle capture were also examined. The mesh most suitable was a PM 2.5 mesh which is used specifically for the purpose of allowing air flow while filtering airborne particles.

The collection of these particles was also tested in an outdoor environment over the course of 16 days, revealing a very legible increase in coloration over time (Fig.4b).

iii. Sentience
The sentience of each tree is controlled by four factors which affect particle flow and mist behavior.
A bending flex sensor is used to determine the wind force and direction, which determines which misters to activate. To know how much mist to spray, a low cost particle sensor is mounted to provide real-time pollen counts and programmed to detect a range between 2.5-10 μm. The quantity and lifespan of mist is dependent on the temperature and humidity levels, which are read by a weather shield (Fig.4.b). The four data sets are then networked to the other sentient trees, which communicate the quantity, duration, and geometry of the mist clouds to be produced in response (Fig.4b).



iv. Mist
To increase the chances of particle capture, mist is used to collide with the airborne particles, making them both heavier and more likely to adhere to the mesh. The size of the atomized water should be close to that of the desired particles being captured in order to avoid the slip stream effect, which is created when particles are too different in size, creating a difference in air pressure around them and essentially causing the smaller ones to slip past the larger. The misters chosen for the set up were Kirry Tank with Quick Fogger Nozzles provided by Spraying Systems Co., Japan, which sprayed atomized droplets in a range of 7.6~ 11.2 μm (Fig.4b).

Behavioral Procedure

The following describes the sequence of how the above mentioned elements are networked (Fig. 4c).
Wind blows airborne particles onto the site. The particle sensors detect the quantity of particles present relative to their locations while the flex sensors are able to measure the wind speed as well as the wind direction. The wind and particle information is then combined with the humidity and temperature levels measured by the weather shield, which are all used to decide which misters to activate and how much mist to spray. The mist collides with the airborne particles, causing them to either stick to the mesh, or to eventually be weighted down to the ground. As time goes by and the process continues the mesh are gradually colored, revealing the differences of the pollen levels over time, while the mist cloud being produced is indicative of the real-time condition (Fig. 4d).

**IV. Case Study**

Developed as a part of an architectural competition, Tokyo In(di)visible was built as an interior installation fitting a bounding box of 2.4 x 2.4 x 2.4 m. It was composed of fifty-two artificial trees varying in size and height made out of laser cut wood pieces between 6 and 8 mm (Fig.5a). In cases where the rotation between pieces was more than 80 degrees, a 3D printed joint unique to each rotation was used to join the tensegrity components (Fig. 5c), which were then compressed by a 1 mm thick stainless steel cable (Fig. 5b). The PM 2.5 mesh was laser cut and mounted on each structure. Located around a real tree that was used to define the hanami space, the artificial trees formed a porous barrier functioning as an outdoor air filter—a thick boundary that varied between 700 mm and 2400 mm. The four artificial trees at each corner of the square footprint were specially designed to incorporate four mister nozzles, which were each connected to two tubes; one to an air compressor and another one to a pressurized water tank. Each of the four air tubes were connected to a solenoid valve that was controlled by an Arduino which was connected to a computer (Fig. 5d). The valves were then activated by reading the wind data from an excel sheet.

The final result was an orchestrated response of mist in response to wind speed and direction, which while performing with the intention of capturing pollen, changed the perception of the space through the quantities and qualities of the mist; blurring the visual and audible relationship with the installation while also altering temperature and humidity values, ultimately heightening the sensorial experience, hence yielding what was earlier referred to as a computed immersive environment.

The word “immerse” describes the action of making oneself fully involved in a certain activity, interest or experience. This can be achieved through different parameters where creating an atmosphere promotes experiential engagement through isolation. However, this isolation isn’t necessarily achieved by a physical barrier, but rather by an appeal to the sensorial system.

As the focus of the experience is around the hanami and the viewing of the sakura (cherry blossom trees), the heights of each artificial tree are determined by their proximities to real trees; smaller when closer, and larger when farther away, ultimately enhancing the viewing by forming a human scaled semi-enclosure around the tree (Fig.5a), while also providing a supplementary forest to wander from space to space (Fig. 3d).

The particle count in the air is made visible through the amount and locations of the mist dispersed controlled computationally (Fig.5d,e). The mist, although responsive and designed to increase particle capture, contributes to the immersive effect of the space by heterogeneously blurring the surroundings in terms of vision and sounds, thereby, through a form of sensorial isolation, produces an affective atmosphere for hanami. 

Through the differentiated transformations within each artificial tree the local wind force and direction can be read. Finally the colorations on the mesh reveal different zones of particle intensity as they accumulate over time.

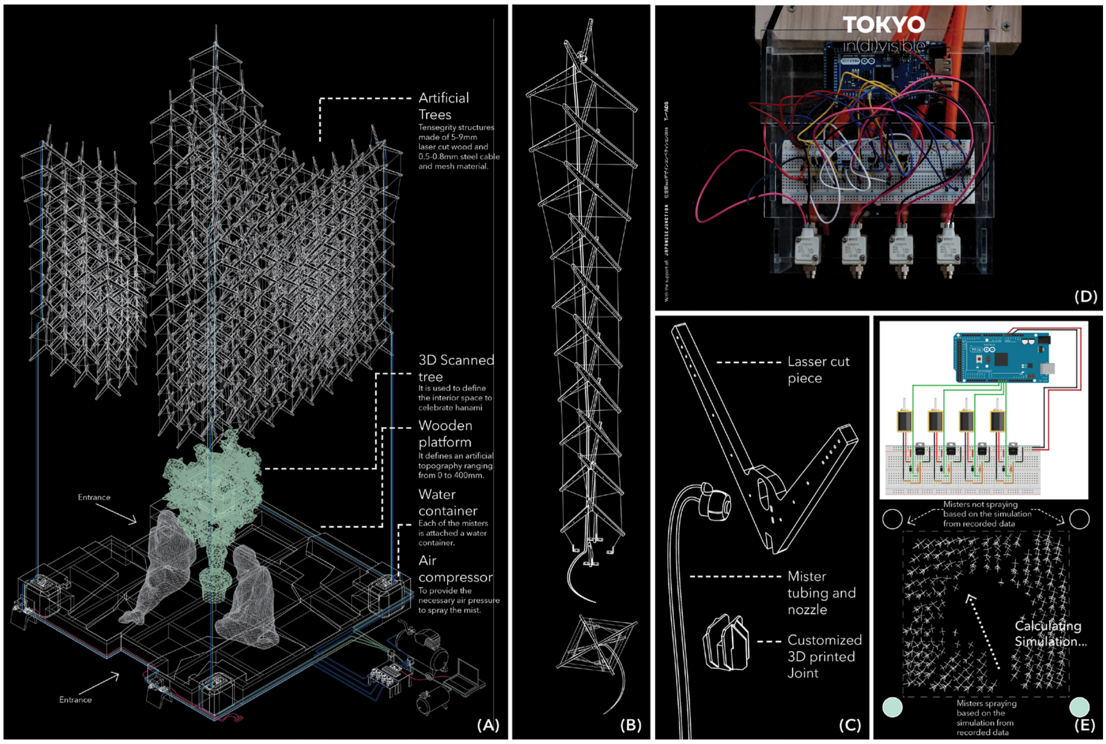


Fig.5. Prototype Overview. (A) Case study exploded axonometric. (B) Artificial tree. (C) Artificial tree components. (D) Arduino and solenoid valves. (E) Simulation view.

## VI. Results and Conclusion

The case study successfully demonstrated the interconnectivity of the system and set-up, using the pre-recorded data as a means to activate and orchestrate the four different misters in their respective locations. However, because the installation was located indoors for the purpose of the exhibition, some of the performative aspects will be tested at a later date. These tests will primarily be conducted in order to evaluate the efficiency of pollen capture and the effects the structures have on wind obstruction and flow; the authors believe that any such changes will be minor. It was also revealed that the particle sensors were not able to distinguish between particulate matter and the atomized water droplets, as they were of a similar size. This could potentially be resolved by creating a delay between the mist spraying and the next particle count, reducing the confusion in the particle count.

Finally, the water being used to produce the mist is currently being sourced from tanks, yet future developments will seek to source the water collected directly from rainfall as well as by recollecting it from the sprayed mist captured on the mesh. This advancement could require fine tuning the mesh geometry to maximize water flow/dripping while maintaining pollen capture performance, as well as including a water retention system with some filtration methods to separate particles from the water—in so doing, the system would become further integrated into the urban ecology.


Fig.6. Final Built Proposal



The proposal hypothesized that architecture could become both a record and an active contributor in the urban cycle, both as data and as a function. On one hand, it sought to address the spatial divide created by pollen pollution in the outdoor environment. On the other, its aim was to heighten the experience of hanami by producing a computed immersive environment. In this sense, the two events are not understood as separate things, but intertwined contingencies (Fig.6).

COCA MEDIACCIONES


## Credits:

Research and Project Concept and Development: Deborah Lopez and Hadin Charbel
Computational Support: Rafael Gonçalves and Anders Rod
Fabrication Support: Jiang Lai, Tyler McBeth, Mika Kaibara Portugaise, Nathalia Rotelli, Veronika Smetanina, Rūta Stankevičiūtė.
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## BIO/CV:



Déborah López y Hadin Charbel investigan las potenciales relaciones entre seres humanos y herramientas computacionales en el proceso de fabricación como candidatos a doctorado en la Universidad de Tokio, donde también finalizaron su master post-profesional. Desde 2014 reciben la beca Monbukagakusho scholarship para realizar primero sus estudios de master y en la actualidad llevar a cabo su doctorado. Déborah es arquitecta y finalizó la doble licenciatura de arquitectura y bellas artes en la Universidad Europea de Madrid y su proyecto final de carrera recibió el primer premio en la competición *Premio Luz y Arquitectura a los más innovadores Proyectos Fin de Carrera de Arquitectura de España y Portugal* organizada por Phillips y la Universidad Europea de Madrid. Hadin finalizó su bachelor en arte y arquitectura en UCLA. Juntos recibieron el *Excelence Award* en la *Real Size Competition* en Osaka con la propuesta TOKYO in(di) visible. Recientemente acaban de presentar la investigación llevada a cabo en Obuchi Lab; *The Human Touch in Digital Fabrication* en ACADIA Conference 2016 en la Universidad de Michigan.

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Déborah López and Hadin Charbel are currently researching the potential relationships between humans and computational tools in the fabrication process as PhD candidates at the University of Tokyo, where they also completed their Master's degree. They have been awarded the Monbukagakusho scholarship. Deborah is an architect and received a Bachelor of Arts and Master's of Architecture from the European University of Madrid. Her Master Thesis Transerai received first prize in the competition *Premio Luz y Arquitectura a los más innovadores Proyectos Fin de Carrera de Arquitectura de España y Portugal* organized by Phillips and The European University of Madrid. Hadin received a Bachelor of Arts in Architecture from UCLA. Together they received the *Excellence Award* at the *Real Size Competition* in Osaka. They have recently presented the research conducted at Obuchi Lab; "The Human Touch in Digital Fabrication" at the 2016 ACADIA Conference at The University of Michigan.

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