

SENSEABLE CITY GUIDE
TO **MUNICH**



MUNICH
SENSEABLE CITY GUIDE

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SENSEABLE CITY GUIDE WORLD MAP

Welcome to the Senseable City Lab – a cutting-edge multidisciplinary research group that studies the interface between cities, people, and technologies and investigates how the ubiquity of digital devices and the various telecommunication networks that augment our cities, are impacting urban living. With an overall goal of anticipating future trends, we bring together researchers from over a dozen academic disciplines to work on groundbreaking ideas and innovative real-world demonstrations.

Each academic year, the Senseable City Lab invites students at the Massachusetts Institute of Technology to participate in the Digital City Design Workshop. The workshop seeks to provide pragmatic, technological solutions that address a key concern of urban living. The Senseable City Guide series showcases this research which is undertaken in partnership with cities from across the world.



SENSEABLE CITY LAB – MIT – BOSTON



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Munich Introduction

by Fábio Duarte

Airports are the nexus of global business: a concrete sign of how people connect, exchange experiences and ideas, and foster novel ways to face current challenges and think about possible futures.

LabCampus is a future-focused innovation campus connected to Munich Airport, with links to over 260 airports worldwide and easy train connection to the capital of Bavaria, a traditional center for innovation in Germany. LabCampus intends to foster interdisciplinary collaboration between companies and industries. The Senseable City Lab has been working with LabCampus to explore the unique opportunity to conceive possibilities to incorporate digital technologies in order to activate open spaces on the site. Employees will have the opportunity to enjoy public areas that will weave the buildings together, and companies can explore this chance to enhance the social networks that will emerge from these encounters.

During the 2019 Digital City Design Workshop, a graduate student cohort were tasked with designing interventions to leverage the use of digital technologies to activate public areas on LabCampus and foster creativity among companies and users.

Nicolas Ayoub combines the avant-garde artistic tradition of Munich with the city's strength in technological development. Building on the modernist art movement called Der Blaue Reiter (the Blue Horserider), an art movement founded in the Munich in 1911, which included names as Wassily Kandinsky, Marc Franz and Paul Klee, Ayoub proposes to use art to promote

social interactions and innovations. In Reiter, autonomous vehicles and urban furniture exchange data to create digital art landscapes. As the vehicles move around LabCampus, they "contaminate" bus stops, building façades, and urban furniture with colors and light, also allowing direct interaction by users.

In SensHack Garden, Martina Mazzarello proposes to use community gardens to bring people together. But different from traditional community gardens, which are characterized by rudimentary technologies, Mazzarello uses digital technologies at both the user and the garden ends of the experience. Users create a profile, choose the plant typology, and the system controls the levels of water, temperature, humidity, and nutrients needed by each vegetable species in the multiple gardens distributed in LabCampus. But Mazzarello still promotes an active engagement between users, growing and sharing their produce, leveraging the agricultural traditions of Bavaria, and uses SensHack Garden as a metaphor of growing together: LabCampus, your own food, and your own community.

Two factors exemplify the global outreach of LabCampus: technological innovation and the airport, an international hub serving more than 46 million passengers per year. Skyface, by Sijia Zhong, connects technology and airport through its ethereal element: the sky. Skyface is an art installation which showcases LabCampus's role as a global connector of innovation by using sky as a commonality we all share. On exterior or interior walls, ceilings and installations around LabCampus,

or at the airport, the user scans the boarding pass and sees her / his trip among all other flights arriving at and departing from Munich airport, as well as live footage of the sky in many airports around the world, and the starry night sky we all have above us.

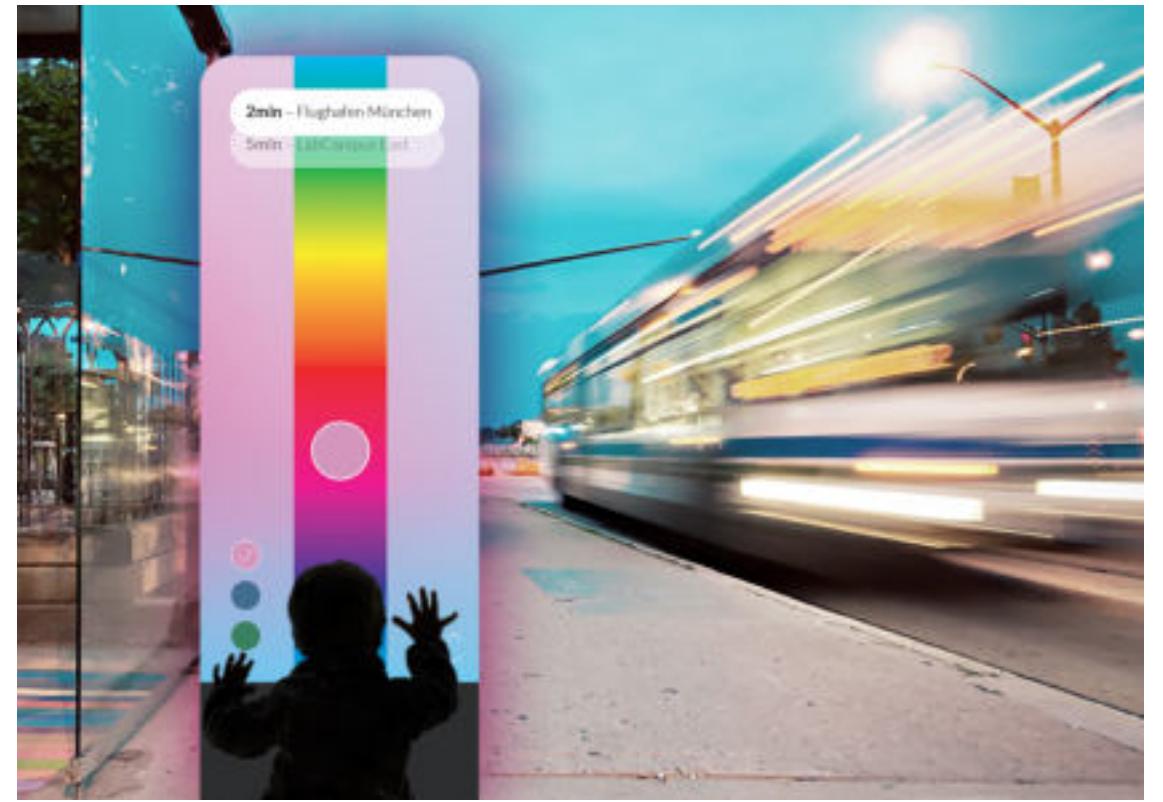
Another intangible element of airport is sound: the tight schedule of flights crisscrossing the sky creates a particular soundscape that is unique to airports. Noise, movement, water, breeze What would happen if they collide? This is the question driving Soundflux, by Zhaodi Wang. The project proposes a series of water features in LabCampus that are responsive to the noise level of the surrounding environment, and at the same time coordinates with human activities and environmental elements, such as wind direction and humidity. Soundflux intends to trigger human interaction and provide a comfortable public space.

When the first companies settle on LabCampus, people will interact and ideas will be generated in unexpected ways. Building on the tradition of German beer gardens, Han Ning Tsai proposes the LabMUG: a series of plastic mugs with removable smart coasters. Users can log in their profile, with personal and professional interests, and social media links, into the coaster; and when they toast, they exchange information. By stimulating the social interactions that happen on beer gardens, LabMUG can also become an apparatus for mapping the social dynamics of the campus, giving insights to LabCampus on how to stimulate exchanges among different companies.

M1

REITER

by Nicolas Ayoub



SENSEABLE CITY LAB, MIT

PROJECT DESCRIPTION

Located in the Airport cluster, LabCampus is the new vision of the aerotropolis in Munich. The ambition is to develop a unique, future-focused innovation campus will foster interdisciplinary collaboration between companies, startups, and industries. In order to help the actors of LabCampus, it seems essential to incorporate art into the project as it has an extensive history of fostering innovation and creativity.

Based in LabCampus, and the Munich Airport, REITER is a digital landscape art installation that leverages and plays with existing urban furniture and autonomous vehicles to engage people with art, as well as promote social interactions. This unique urban experience will serve as an attractor to both Munich and LabCampus, strengthening the ties between the two and incentivizing people to further engage with art (by visiting

one of the city's eighty museums for instance).

The name of this project comes from Der Blaue Reiter (the Blue Horserider), a unique art movement led by

people achieve a state of synesthesia – which is linked to better wave synchronization, leading to creativity.

As such, REITER serves as an homage to these artists who deeply

"My stay in Munich was the scene of my complete liberation"

Marcel Duchamp

Wassily Kandinsky, Marc Franz and Paul Klee, amongst others, founded in Munich in 1911. This avant-garde group of artists defined what became Expressionism by trying to define a common vocabulary that anchors colors, sounds, and words. This coordination was intended to help

contributed to Munich's history of culture and innovation. The name also echoes to this project as an intersection of art, technology, and mobility. In essence, the objective of REITER is to translate the artists' thinking to the built environment in the 21st century through technology.

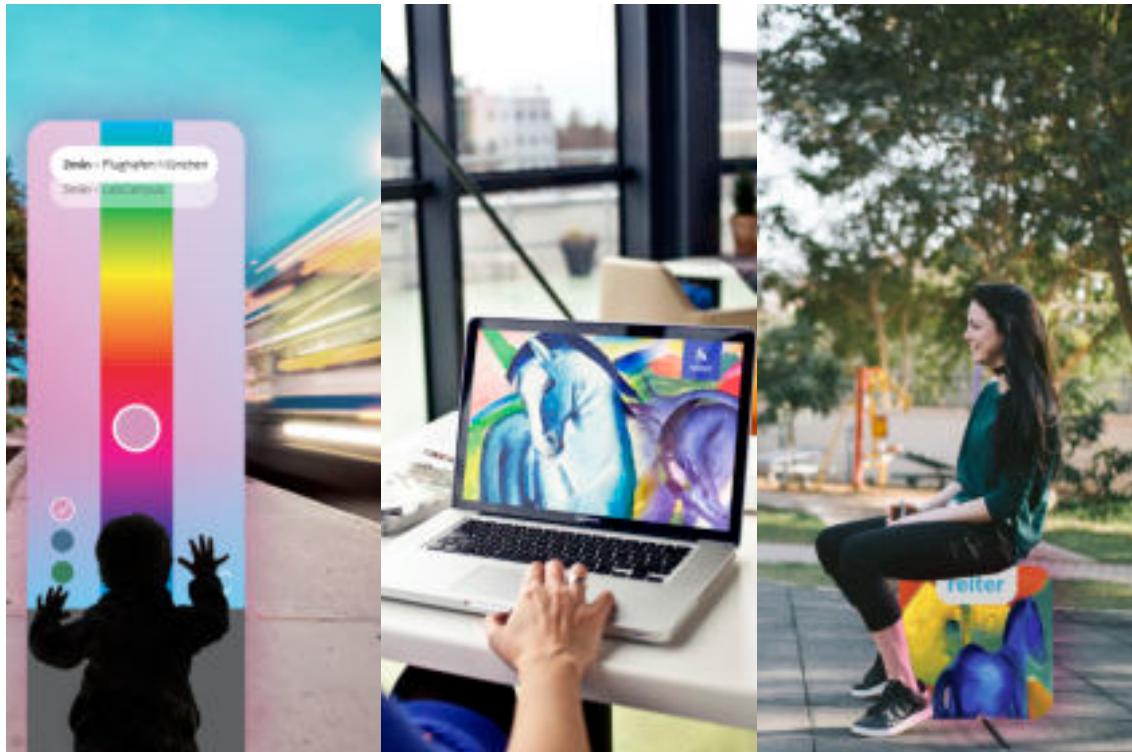


Top Right: Located in the Airport cluster, LabCampus will consist of 500,000 m² floor space for research and development activities across four quadrants.

Left and Bottom Right: The pedestrian path and boulevard of LabCampus is at the center of the project and acts a spine to the different blocks.







PERSONAL INTERACTIONS

REITER is both an active and a passive system. When walking towards an active REITER, the display prompts a hue color picker to select one or multiple colors to combine into a palette. The user is then given the opportunity to draw shapes.

Following this input, several artworks are generated by the system on the display. The creator REITER is then awaiting the next arrival of an Autonomous Shuttle to “infect” it with the newly generated artworks.

The AV Shuttle, as a vector, acts a paintbrush as it spreads art on REITER systems throughout its route in LabCampus and the Munich Airport.

Both the active and passive system build on the interaction to foster social conversations around art.

The generation of art is done by a crowdsourcing experience. Furthermore, with 150,000 daily passengers at Munich Airport, the engagement possibilities are vast. In the case of the bus stop, REITER creates engagement by providing people with a playful interface with which they can interact while waiting for their shuttle.

The project relies as well as on the idea of gamification, as users might guess which artwork will be generated. REITER will also reflect

the global connectivity of this urban space, one of the unique characteristics of LabCampus.

As art is universal and global, REITER allows everyone to experience art at any moment at the street level, whether you are going to work, landing in Munich Airport, working in your office, taking a break at the Park or even strolling through LabCampus’ pedestrian path/piazza.

Left: From input on the active REITER to the output on the open-source passive REITER.

Right: The storyboard explains the active or passive Human-REITER interaction, as well as the infection mechanism.



URBAN INTERACTIONS

As an aerotropolis, LabCampus has a unique location with Munich Airport as its gateway. This transportation hub with links to over 260 destinations worldwide is key to its development and influence.

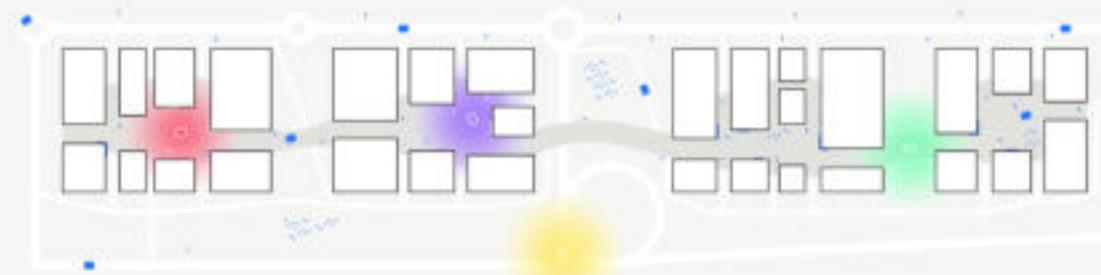
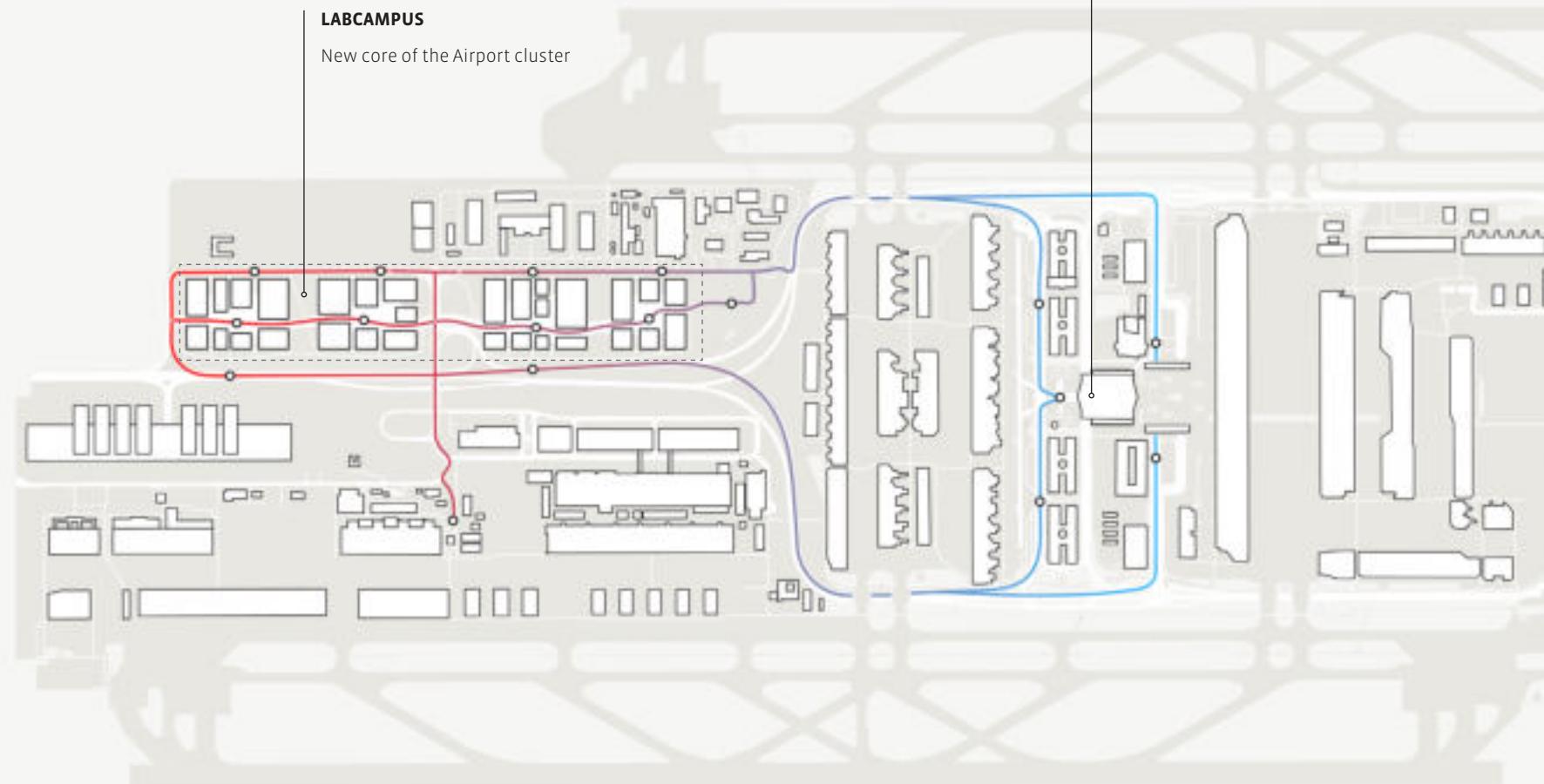
As such, REITER takes advantage of this network and will be present extensively in LabCampus and in selected areas of Munich Airport, particularly at the main gates of the Terminals, serving as an attractor

to LabCampus. By being seamlessly integrated into elements of the built environment, REITER creates a dynamic interaction between buildings, urban furniture, and buses (notably through the notion of infection).

Active REITERs are deployed strategically across both LabCampus and the Airport, whereas the majority are passive (which means that they only get infected but do not infect) in

order to be cost-efficient. The system being also open-source, enables users to access it remotely at the office, thus bridging the frontiers between physical and digital landscapes.

The routes of the AV Shuttles were optimized to serve all locations while allowing an extensive diffusion of the artworks across the area, given that each shuttle is the vector of REITER and acts as an urban painter once infected by users on an active system.



MUNICH AIRPORT

The gateway to LabCampus

Top: AV Shuttles infected by REITER are spreading art in LabCampus.

Bottom: AV Shuttle system from Airport, S-Bahn stations and LabCampus.

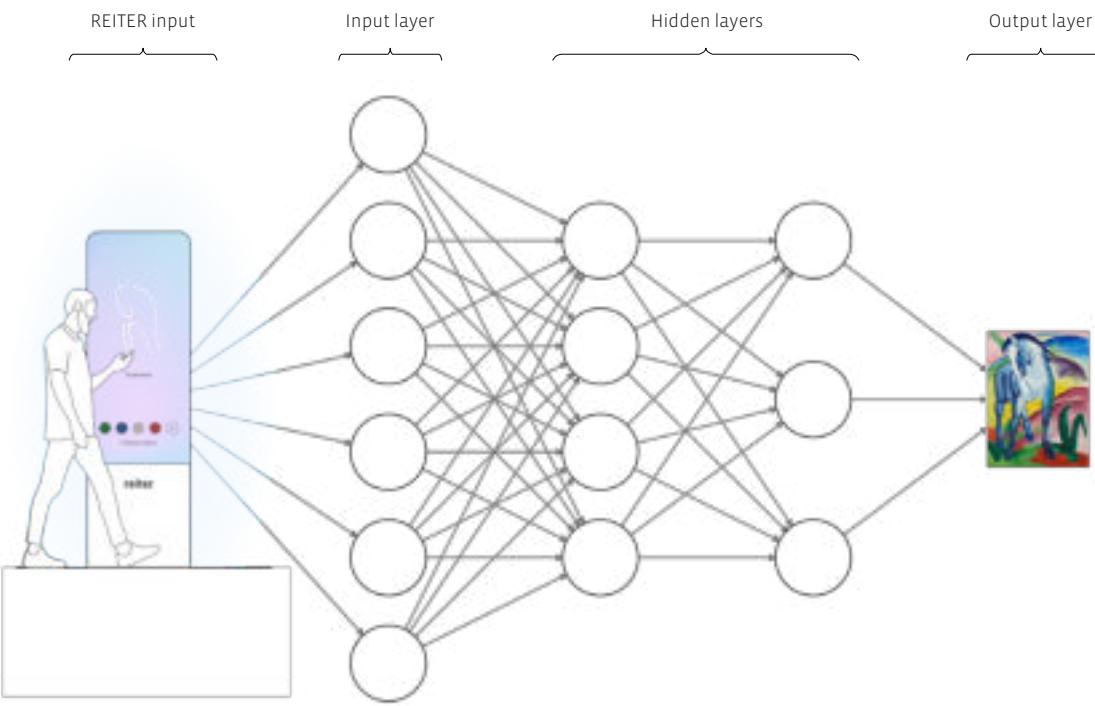


Diagram of REITER's Art Selection Engine.

TECHNOLOGY DESCRIPTION

REITER is an urban contamination system composed of active and passive devices as well as carriers – Autonomous Vehicle shuttles – that creates a digital landscape installation in LabCampus.

The system architecture follows the user interaction of picking colors (palette) and optionally draw shapes. These inputs are then processed by the Art Selection Engine, a deep learning system that associates the color palette and shape to a Content Management System linked to a cloud database of artworks related to Munich. The artworks are either from artists that lived/were born in Munich or present in Bavarian museums.

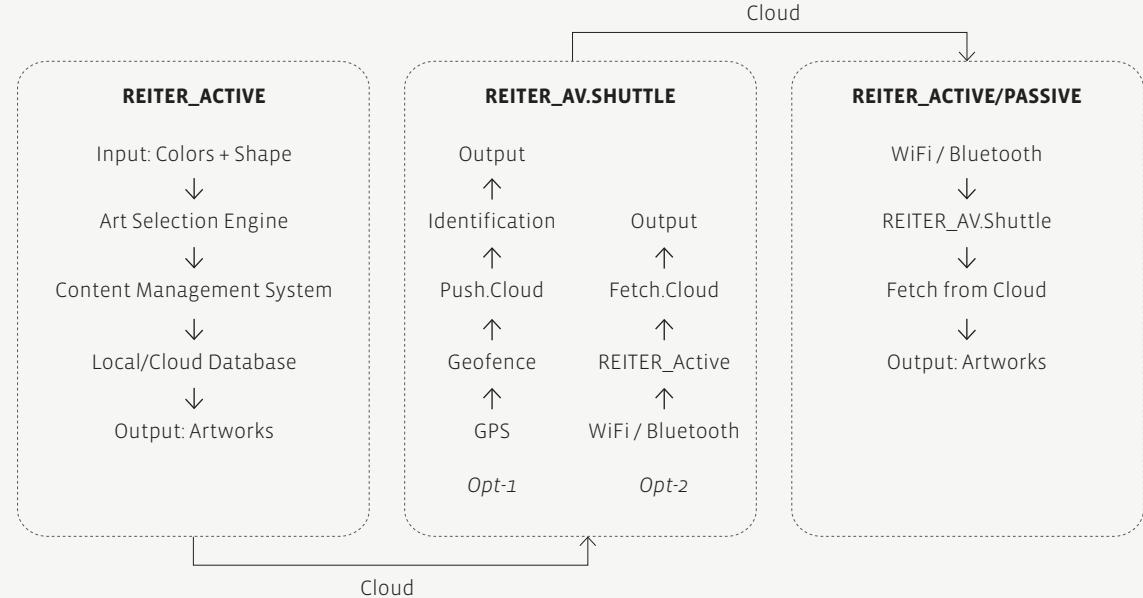
Once the artworks are generated by the Art Selection Engine, they appear on the current device waiting to “infect” an AV Shuttle. The latter is able to retrieve the artworks from the REITER.Active in two ways: either through an interconnection of WiFi and Bluetooth, thus fetching the artworks from the cloud, or through geofencing with GPS, thus pushing from the cloud with a unique ID. When the infection takes place the bus evolves into a carrier and showcases the artworks until it gets re-infected.

Acting as a paintbrush, the AV Shuttle will contaminate active and passive REITERs during its route by following

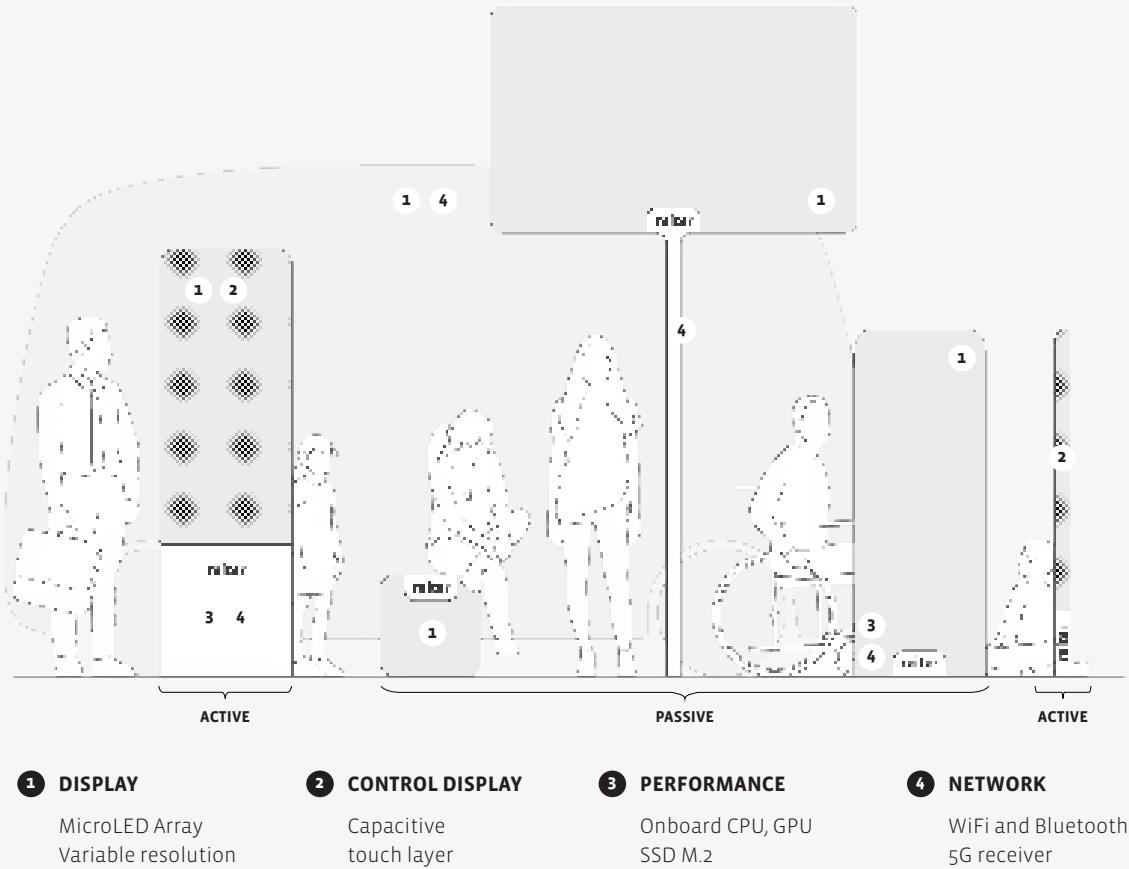
the same protocol, thus spreading art throughout LabCampus and creating a digital landscape.

REITER is composed of active and passive devices that act as urban furnitures, such as bus stops, information panels, seats, basketball hoops, light poles... The passive system features a MicroLED Array display of variable resolution, an onboard CPU, GPU as well as an M.2 SSD hard drive. It also has WiFi and Bluetooth receivers along with a 5G antenna. Relying on the passive hardware, the active system features a capacitive touch layer on top of the MicroLED Array display to enable user interaction for colors and drawing.

ARCHITECTURE



HARDWARE



1 DISPLAY

MicroLED Array
Variable resolution

2 CONTROL DISPLAY

Capacitive
touch layer

3 PERFORMANCE

Onboard CPU, GPU
SSD M.2

4 NETWORK

WiFi and Bluetooth
5G receiver



NICOLAS AYOUB

Nicolas is an interdisciplinary designer, architect and strategist from Paris, France. He is currently pursuing a Master's degree in Design Studies in Technology at the Harvard Graduate School of Design. He works at the nexus of society, technology and the built environment. Trained as an architect, he combines his academic studies with experience at internationally renowned architecture and urban planning practices in Europe and Asia.

M2

SensHack Garden

by Martina Mazzarello



SENSEABLE CITY LAB, MIT

PROJECT DESCRIPTION

The development of a new site in the northwestern area of the airport of Munich is facing a new significant challenge impacting Bavaria's territory and both the future and existing community living and working there.

The analysis of state of the art on the site visit and LabCampus' data shows that the primary mission of the project is to curate an interdisciplinary innovation center that serves as a dynamic system of cooperation between companies, industries and potential customers and partners. What emerged is a need to foster collaboration in between the future communities inside and outside the LabCampus area.

It is an area of 50 hectares that will host approximately 4000 people in the first stage of the area development alone. That reflects a need to focus on social aggregation between people and to create input for multiple stakeholders to collaborate on a shared vision.

A final objective is to create an energetic and attractive place that facilitates face-to-face connections, thus increasing the combinatorial possibilities of the network.

It will be an innovation and high tech area but despite that the project is rooted in the concept of a community vegetable garden as a system of actions and interactions between people, plants and the environment. It builds connections with the agricultural traditions of the area through the metaphor of growing

together: LabCampus, your own food, and your own community.

Moreover, current literature reveals how urban and community vegetable gardens are an increasing phenomenon with the ability to build strong community capacity. Community gardening fosters neighborhood ownership and civic pride which in turn build a constituent base for policy agendas (Twiss et al., 2011). They are not only "food, community and culture makers," but they are able to produce hope, like an opportunity for the collective imaginary (Hou et al., 2009). Gardens can act as incubators of social practices, a physical connection, and a filter between the local context and the environment through different lines of aggregations. They play a role in social integration, a new path to

specific objectives; robotic arms are continually taking care of plants through the inputs received, measuring the levels of water, temperature, humidity, and nutrients needed by each vegetable species. When the vegetable is finally ripe, the user can pick up, donate to the LabCampus canteen, or celebrate during SensHack temporary events.

The technology on one side utilizes advanced data visualizations and sensors that measure the plants' biologic conditions and let visitors always be connected to the farm (digitally or remotely). On the other hand, it is used for the customization of plants' biosphere with the possibility of experimenting with different forms and tastes.

The expected result is an acupuncture approach as a connection that

An energetic and attractive place to exchange

simultaneously meet social needs and create social collaboration (Murray et al., 2010).

SensHack Garden is an automated vegetable garden system that allows users to grow their own vegetable with a real-time interaction both digitally and physically.

The user can create a profile, choose the plant typology, the location in the LabCampus area and his

facilitates relationships that break down the definitions of roles in the community at all levels of the entire social system: individual-community-territory-cities.

Right: Project scenario





PERSONAL INTERACTIONS

SensHack Garden is a completely automated vegetable green system that allows users to grow their own vegetables with a real-time interaction both digitally and physically.

Through a device it is possible to create a profile easily and choose an available spot within LabCampus. When choosing the precise location, some species are suggested based on the plants already present in the immediate vicinity, the potential to create a seasonal composition, and the dimensions required.

As an automated system with robotic arms moving on rails that can be anywhere on the campus,

it is performative, an attraction for people while it monitors regularly the status of the plant using sensors.

Hacking plants

The system will give the possibility to entirely hack the plant, giving the freedom to manipulate and experiment with the biosphere's plant, creating fresh vegetables, with a different taste, nutrients, and texture.

When the vegetable is ready, you can choose to pick up and bring to your home, donate to the LabCampus canteen, or to celebrate during the SensHack events, as a showcase of the surrounding territory.

Guests will have the possibility to name their own creation, access their growing history and start other experiments, all while rating and commenting on them and looking at other user's creations.

Some suggestions for meetings with other "SensHack growers" can be gathered during the process and social connections are woven throughout the co-creation and growing of vegetables. With this technology, people can learn from each other, compare their products, and share contacts and photos on social networks.

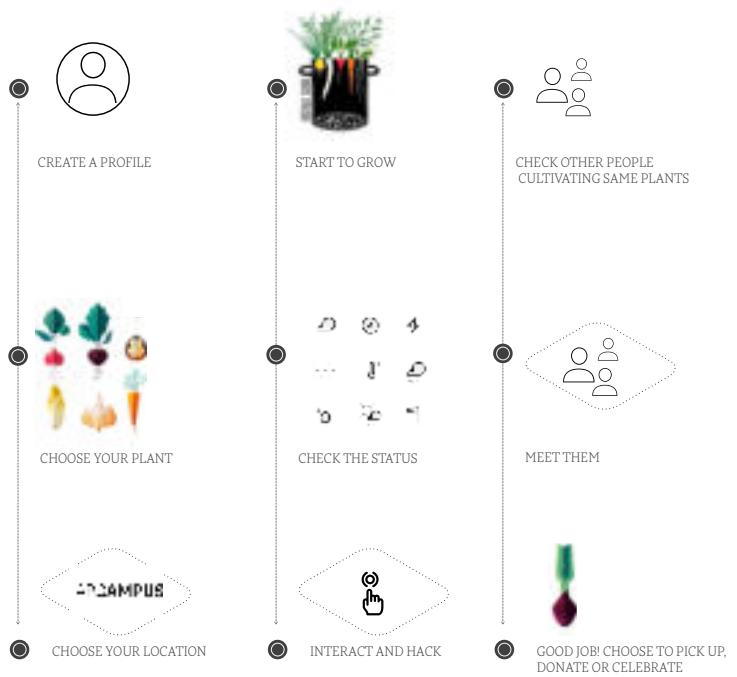
Furthermore, SensHack Garden can monitor food habits, promoting

responsible food consumption.

This system won't be an attempt to replace agricultural manual labor with automation; it aims to be a social experiment to create awareness of raw materials, the environment, and food production. It offers the possibility of growing even during daily working life: a vibrant and social experience to grow your own product in a funny and interactive way.

Hacking spaces.

For the site developers, a catalog of SensHack elements is available in order to be adapted and used to hack every space of the LabCampus area. These guidelines act as a set of tools to spread the project in a powerful way.



Top: SensHack user's interface

Right: SensHack process and user experience

URBAN INTERACTIONS

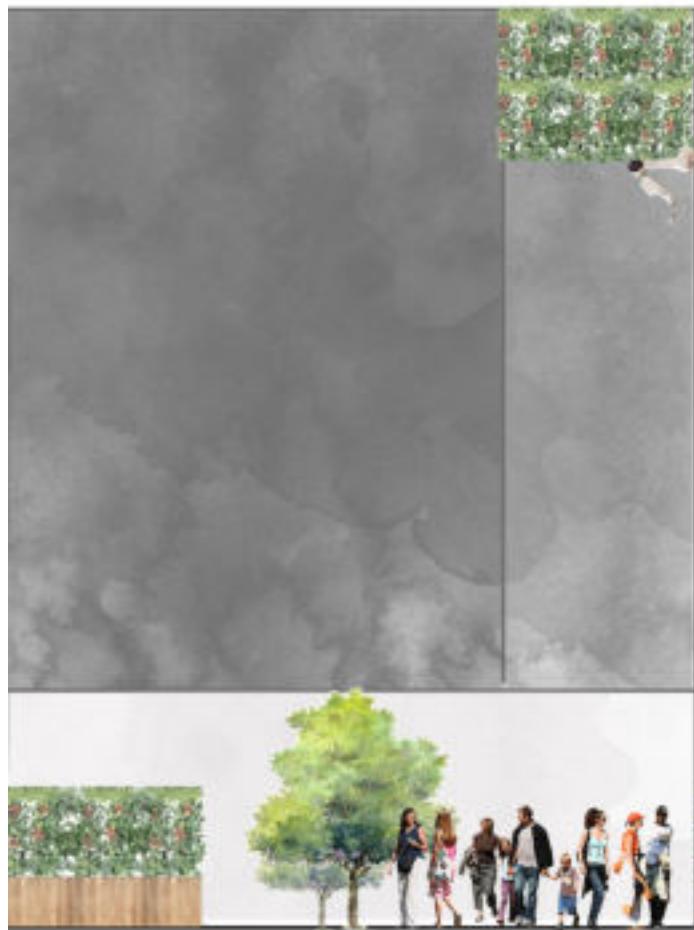
SensHack Garden aims at creating connections, with the future food system becoming a main attraction for tech-savvy travelers, curious people or passionate gardeners from all around the world.

It empowers people to experiment with how technology can involve them in a new social experience within an unexpected setting, aiding everyone to grow food and to grow food to share. Involving people in the experience of co-creating their food will be visible and engaging for

people outside the area through a system of events.

All the events are related to experiences of zero-mile sophisticated food; Inviting chefs around the world that through interacting with robots, can craft a dinner with unique ingredients. Moreover, “taste new flavors” events, cooking classes, green Happy Hours, and make your own beer events, form connections with Bavarian traditions.

Events will be a celebration of food products.



A connection with the food future system in an unexpected setting

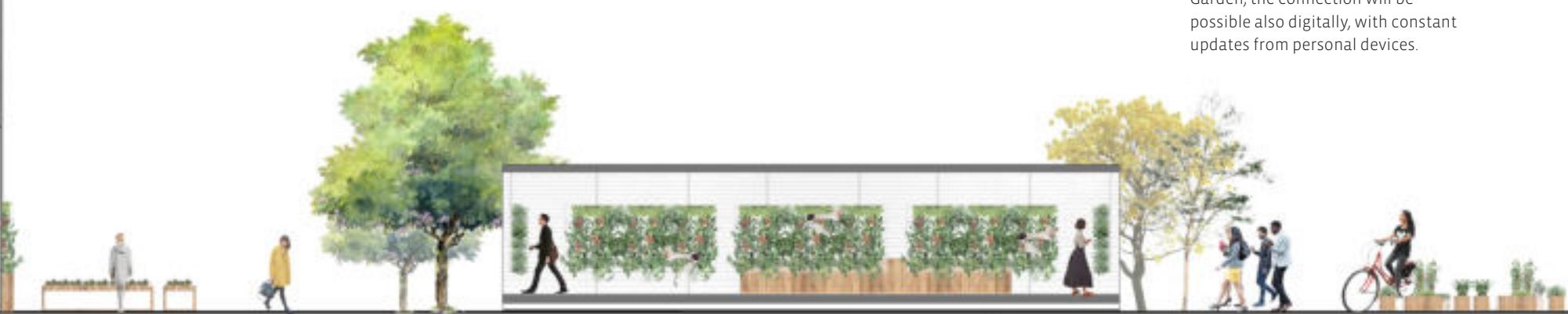


Right: Urban section of LabCampus area
Top: SenHack events view

Grow together

Fresh products will be inspired by the flavor of the vegetables and herbs, probably like nothing ever experienced before, different ways to enjoy food and its smells, flavors and textures.

For those who do not have the opportunity to visit the area, or are passing by arriving at the Munich airport, or still planning to visit LabCampus but want to contribute and interact with the SensHack Garden, the connection will be possible also digitally, with constant updates from personal devices.



TECHNOLOGY DESCRIPTION

Outfitted with sensors, cameras, and circuit boards this project is also an educational tool to learn the impact of personal actions and interactions, along with a rating system to improve challenges and products.

The Artificial Intelligence system is composed by a Cartesian coordinate robot machine, moving through rails both horizontally and vertically.

The software runs through a web interface, allowing the machine to be controlled through a web-based and mobile app interface which enables remote access from any location on most internet devices.

There is the possibility to adjust different inputs including water, fertilizer and pesticide, seed spacing and other environmental factors including soil and weather conditions based on sensor readings, location, and time of the year.

A controlled environment agriculture technology platform that uses robotic systems with sensors, actuators, and machine vision can study and then replicate optimal growing conditions for food, changing everything from the pattern of the UV lights used to the salinity of water and the nutrients added.

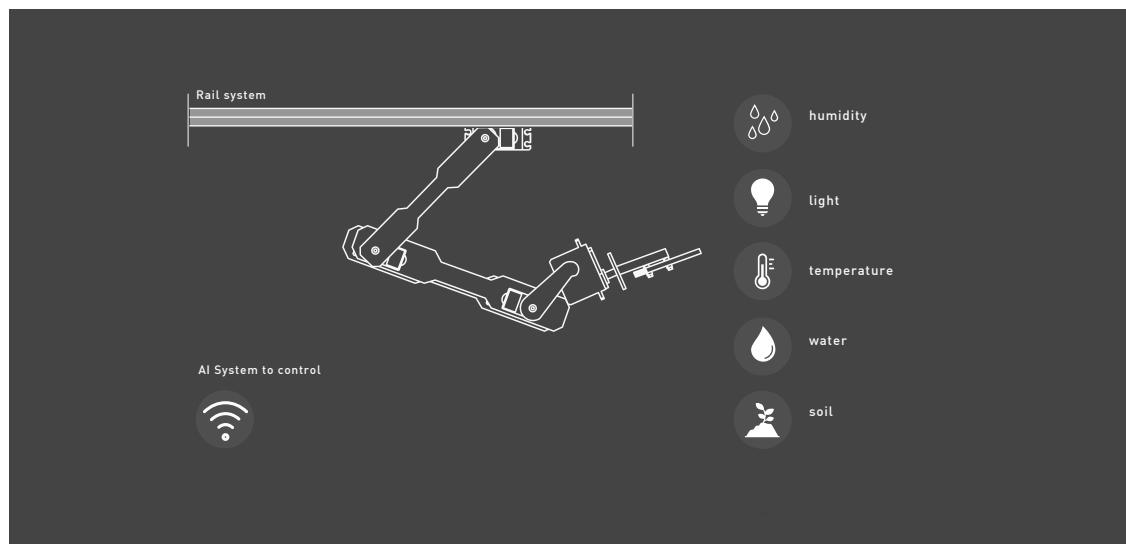
There is a spectrum of control so that users can make their growing experience as involved or as automated as they would like, modulating intensity, position, and color of UV lights, with the possibility of fresh products' customization.

The plants can grow in an aeroponic system, where plants are suspended in a partly closed/fully enclosed system. With the roots suspended, a nutrient-rich water solution is sprayed or misted onto the roots.

There is also a hydroponic system, a

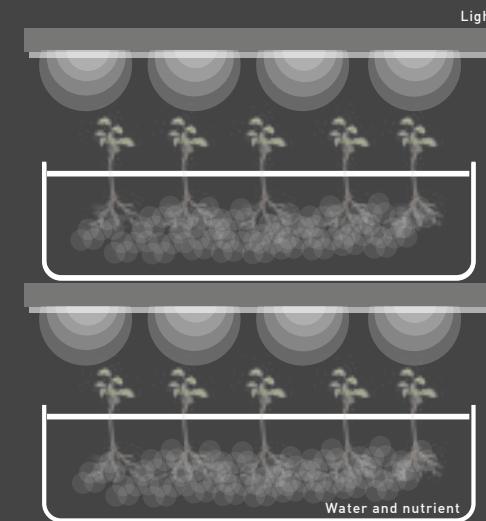
water-based, nutrient-rich solution. Hydroponics does not use soil; instead, the root system is supported using an inert medium such as perlite, rockwool, clay pellets, peat moss, or vermiculite.

A third possibility is to cultivate with regular soil, mainly suggested for outdoor and horizontal settings.

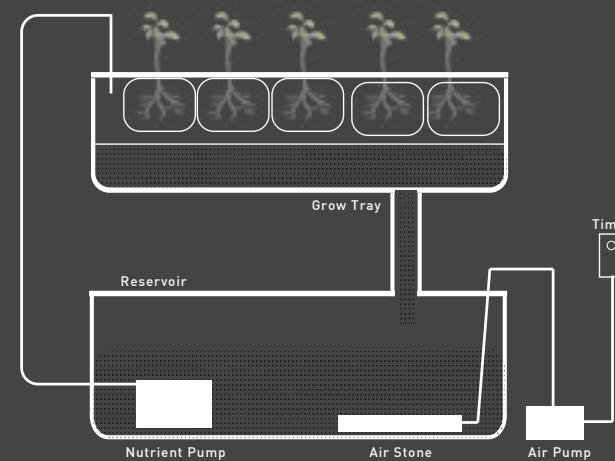


Bottom: Automated system with a robotic arm
Right: Hydroponic and Aeroponic cultivation

AEROPONIC SYSTEM



HYDROPONIC SYSTEM



Typology



System



robot



without

Biosphere



humidity



light



temperature



water



soil





MARTINA MAZZARELLO

is a Spatial designer and Ph.D. student at Politecnico di Milano (Italy) and visiting Ph.D. student at the Senseable City Lab (MIT, Massachusetts Institute of Technology). She has a Master's degree in Interior Design (2015) at the Politecnico di Milano (Italy) after an exchange program at Tongji University in Shanghai (China). She has been working in the Design Department of Politecnico di Milano since 2016, as Fellow researcher, focusing on public spaces and services as dynamic systems of human actions and interactions.

M3

SKYFACE

by Sijia Zhong



SENSEABLE CITY LAB, MIT

PROJECT DESCRIPTION

How can we make maximum good use of invisible information embedded in the visible landscape? Like how the rooftop is “the fifth facade” of buildings, the sky can be perceived as a constellation of cities. If the sky is the canvas, then the planes are the brush, which paint an ever-changing drawing. The flight routes in the air create a unique urban landscape, especially in an area adjacent to an air-traffic hub like the Munich Airport.

SKYFACE is an art installation which showcases LabCampus’s role as a global connector of innovation by mapping where people come and go. It uses the sky functionally and as a commonality we all share. By tracking people, it poetically creates a juxtaposition between LabCampus as a global connector as well as the connections in the sky.

The development of Munich Airport will bring an immense number of visitors and tourists, which creates the opportunity to engage and connect the character of the “sky canvas” to the visitors. When I first visited the site, I was attracted by the rushing scene created by the coming and going of planes. And the strategic role of Munich International Airport as a transportation hub reminds me of an ongoing trend of globalization. I am impressed by the dynamic character of today’s world. Then I started to think about how to bring the same spatial experience to whoever visits this place.

SKYFACE is an interactive installation specifically for areas adjacent to global hubs. It aims to create a visually immersive experience for users. By projecting the customized real time sky on indoor skylights, it uses the data to generate a poetic sense of connectivity. It also enables further promotion beyond site boundary.

To use the data in the sky on a more human scale is to inspire a new paradigm of time. First, it encourages individual to be aware of the changes of the living environment. Second, while the technology shortens the physical distance of the world, it is deep in human’s nature to feel nostalgic on another side of the world. So, this project is to create a poetic and immersive spatial experience based on customers’ needs. Therefore, it promotes the spatial connection between city sky as an information canvas and individuals. In other words, it serves as a role of intermediate interface.

It has two layers of interactions. For personal interaction, it shows the global innovation and how people engage and communicate with it.

For urban interaction, it shows the connection between Lab Campus and the world by using the sky as a functional layer of information.

It is a system which is able to be applied to other innovation hubs in the world. The same digital platform creates an opportunity to share the same connectivity.



SKY AS A GLOBAL CONNECTOR

PERSONAL INTERACTIONS

SKYFACE is an interactive art installation. It is a projection system which can be applied to surfaces on different scales. The whole process is composed of three parts.

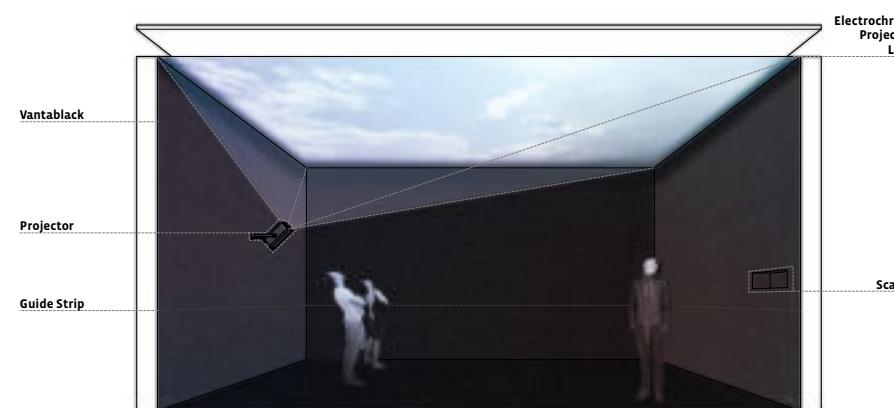
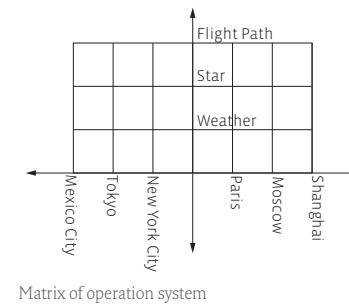
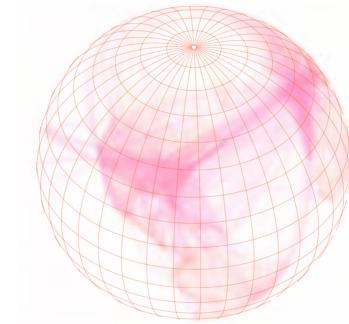
First, with the flight code on their boarding pass, passengers can scan it and activate the system.

Then the system will recognize the destination and departure information. Based on a matrix of space and the selected features of sky, it can identify the relevant data to display.

There are three categories of information to visualize. Users can choose from the weather information, the flight path, or the night sky. A projector hidden in the room will project the customized animation of the selected content on the surface.

The animation will be on a projectable layer of electrochromic film embedded in the surface. To create a more immersive spatial experience, other visible surfaces will be painted dark to keep prominent the illuminated "sky".

By drawing the sky into the plane, users will be visually immersed in the structure that challenges spatial delineations by hosting the view of a changing sky.



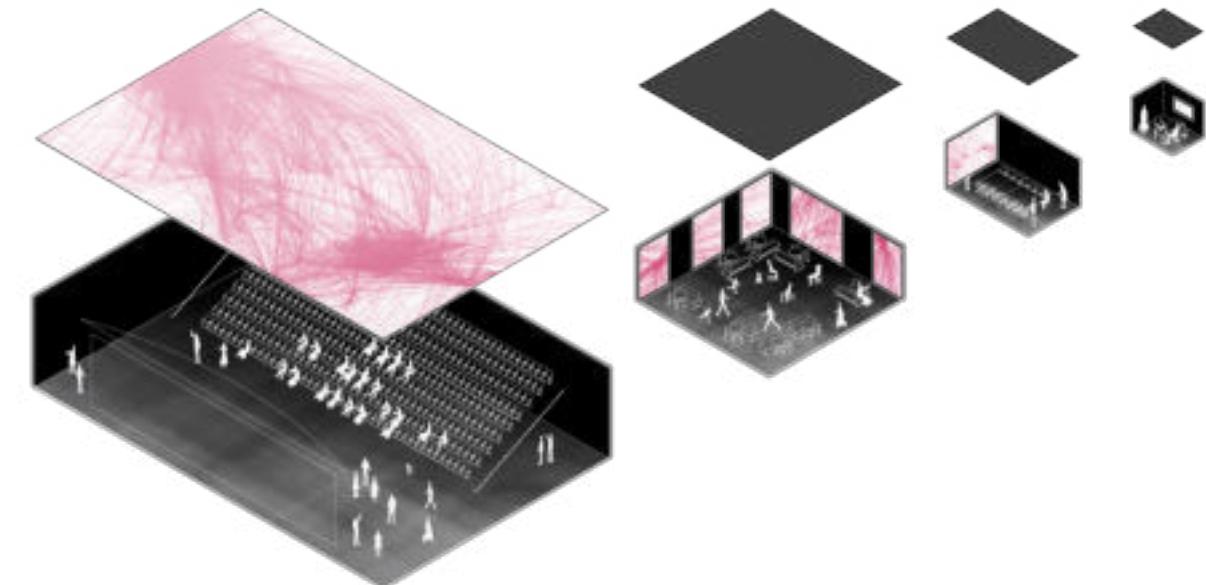
For users who choose weather information, it will show an animation of the changes in weather over a certain period. Its speed will be based on users' choice of duration. Basically, the real-time sky will blend into the digital stimulation of historical or projective scene to create a more continuous experience.

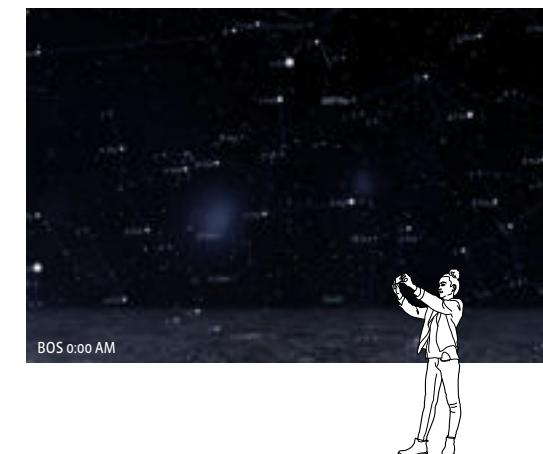
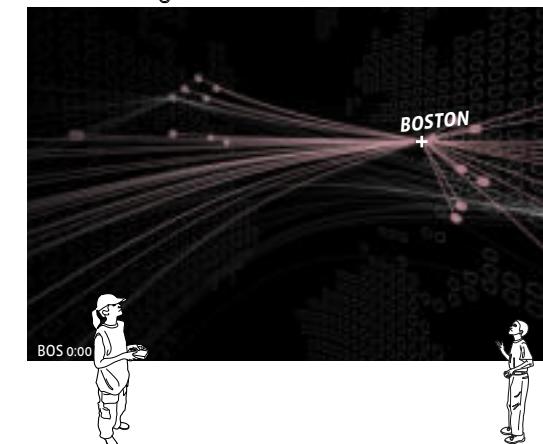
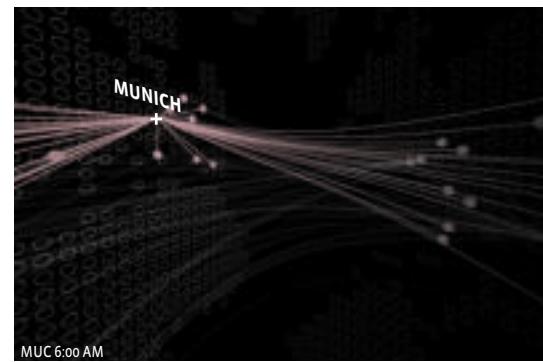
For the flight path, if it is used by non-travelers, it will show the map tracking visitors of LabCampus. In other words, it will map the global connection between LabCampus and all the places where its visitors are from. If it is used by passengers with flight information, the system will operate as a filter to show

the specific historical connection between one place and LabCampus.

For the night sky, it will show the constellation and with a certain duration, the animation will display the star path over time.

SKYFACE is scalable and suitable for interior spaces in different size. It can be applied to many categories of surface or plane based on requirements. It can be projected on the whole ceiling in a large indoor space, like the theatre and the entrance of shopping mall. Besides the ceiling, it can be used on the vertical planes on the wall in lounges.





SKYFACE provides an opportunity for users to gain a new interpretation of time and space.



URBAN INTERACTIONS

SKYFACE is both a lens and a platform for the city of Munich which reveals its position as a global transportation hub and destination. It is more of a platform for LabCampus to showcase its innovation hub as a global connector and the international makeup of the campus.

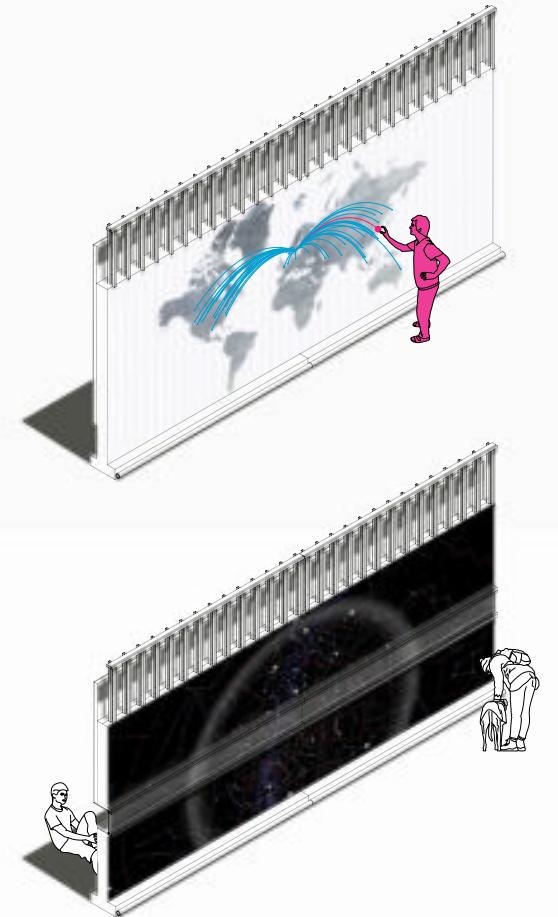
By recording the historical log in activity, the system collects the single connection between each visitor and LabCampus. So it creates a database to visualize where international visitors have come from.

Every time a user activates the system, it shows his spatial connection with LabCampus and it remains as part of this interactive map. So, the interactive map allows users to see and keep adding to the flows of people from around the world.

The stack of historical visiting information will become a map as a representation of the richness of information exchange.

SKYFACE can be used in outdoor environment on an urban scale. It can be implemented in street furniture. It can be applied to the window of stores and restaurants. Furthermore, it can be used on the whole facade of buildings. When more and more people interact with it, the accumulation of data will be much larger.

On a more global scale, the similar system can be applied to other innovation hubs in major airport cities around the world. SKYFACE will help identify the global connecting nature of contemporary world and create a unique social scape.



Multi-functional on urban scale.



TECHNOLOGY DESCRIPTION

SKYFACE will be in a series of components. Each installation has a projector installed and a layer of electrochromic film embedded in the glass. The interior surface will be painted with vantablack to mediate the influence of reflection.

The input will be decided by a matrix of two axes: location and the specific sky feature. There are three parameters: weather, flight path, and the night sky. The tracking of the selected parameter in last 24 hours will be animated and projected as a line of single points. The duration can be customized, and it allows users to have a woven fabric of different paths.

For the flight path, the running system searches and collects the open source files containing individual records. Each file is a CSV spreadsheet with recorded flight information like the altitude, speed, latitude, longitude, time and the route. Then the system will import SOP brings the data into Houdini and assigns point attributes.

Each flight is connected as a line and then filtered. Each path is animated based on takeoff and landing time. Points are converted from a Cartesian system to a spherical globe. All flights are visualized as points using a lat/long coordinate system.

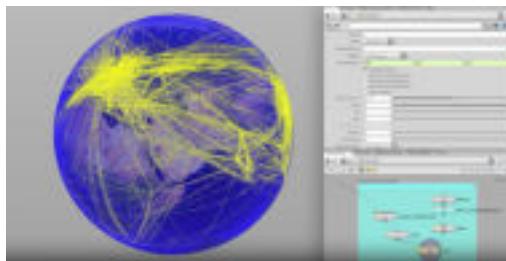
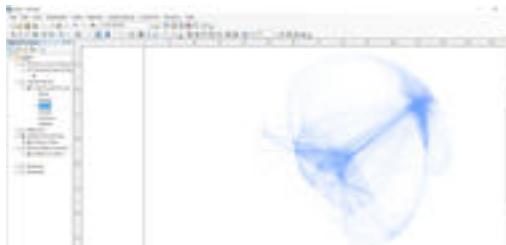
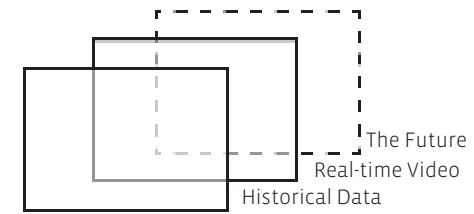
They will be filtered using a scope determined by the users' information and be translated into the representational output.

For the star path, the system will collect data from open source website like the Space Engine.

For the weather animation, it will be a blended combination of real time footage and digital stimulation.

If the user chooses to see the current weather in the place. It will shift to the real time video captured by the camera. If they choose to see the weather in last 7 days, it will be a sped up video composed by historical records.

For the projective future weather change, with the database of point clouds, the deep learning technology will generate digital stimulation of the past and future. The blending system will combine the real time with the stimulation.





SIJIA ZHONG

studies at the Graduate School of Design in Harvard University. She is in the Master of Landscape Architecture program. She is interested in the human interaction with data and visualization.

M4

SOUNDFLUX

by Zhaodi Wang



SENSEABLE CITY LAB, MIT

PROJECT DESCRIPTION

Noise, movement, water, breeze. What would happen if they collide? The project proposes a series of water features in LabCampus that is responsive to the noise level of the surrounding environment, and at the same time coordinates with human activities and environmental elements like wind and humidity.

The most urgent challenge for LabCampus is the contradiction between the design scenario for livable outdoor space and its proximity to the Munich Airport. The average noise level of LabCampus is around 60-65db, which is far beyond the comfortable threshold for human beings. What's more, the noise source of LabCampus is not just the airport. The S1 train and highway on the northern side of the

site are also part of the surrounding environment. The high level of noise is almost impossible to ignore during users' daily activities. In this kind of environment, people prefer to stay protected indoors rather than socialize in outdoor spaces. As such, the social dynamic of the campus is largely influenced by the noise.

However, with the rapid development of technology and changing lifestyles, does noise have to be a nuisance? Do we have to fight against it? Could the noise be celebrated and change our daily lives? What role

could innovative technology play? With these questions, this project explores various ways to decode noise both at urban and personal scales. It aims to utilize noise, a very crucial environmental element, to trigger human interaction and provide a comfortable public space. Let's embrace the lively vibrancy of the airport and active social dynamic in the LabCampus! The busy activities in the sky sometimes could even become surprises!

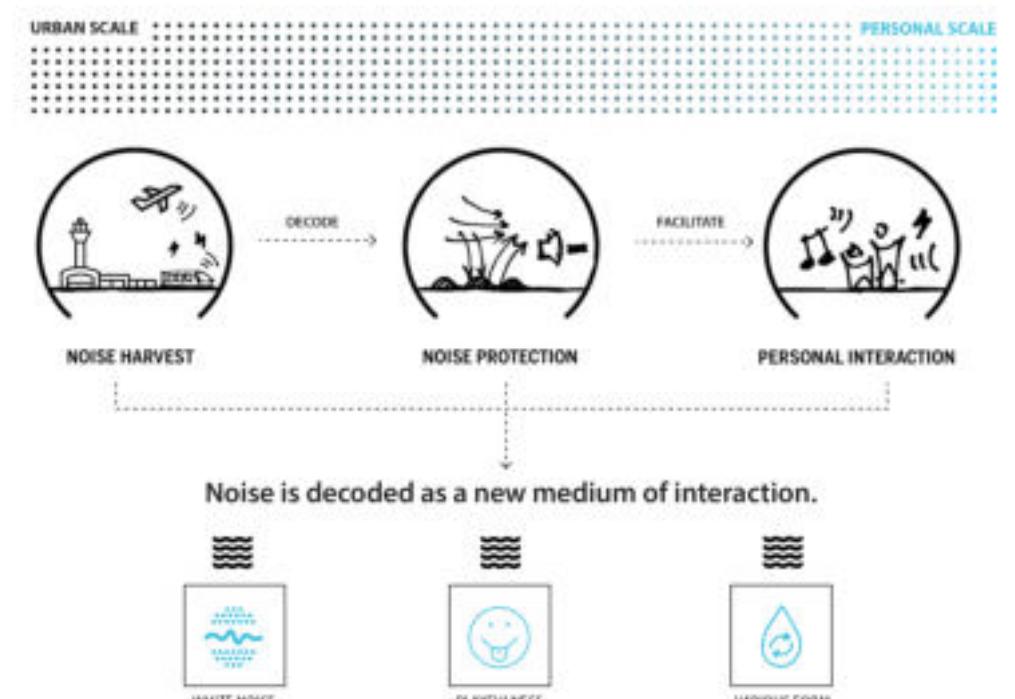
Don't fight against noise, celebrate it!



Scenario
Livable Outdoor Space



Challenge
Airport Noise Pollution



The diagram above explains the conceptual thinking behind the design. Noise from the airport, train, and highway is harvested and sensed through sensors embedded in the environment. And then the collected noise data is processed and decoded, which contributes back to the noise protection of the site. At the same time, personal interactions are facilitated and a livable social dynamic is enhanced. This workflow takes both urban scale and personal scale into consideration. Thus, the noise is decoded as a new medium of human interaction.

Thinking about various tangible ways to tackle the noise condition, water is one of the best options. First, the sound of the active water could provide ambient white noise

- the loudness of water will become a mask to protect people from noise and celebrate the vibrancy of the airport as well. Also, water itself is a playful medium - it brings coolness, relaxation, and lively ambiance. Water could also easily be shaped into various forms like mist, sprays, bubbles, quiet fountains... This flexibility makes it perfect for enhancing human interaction and forming various urban spaces. The noise, decoded into the form of water, becomes playful and vibrant, simultaneously forming flexible urban spaces, and ultimately facilitates personal interaction and public gathering at LabCampus.

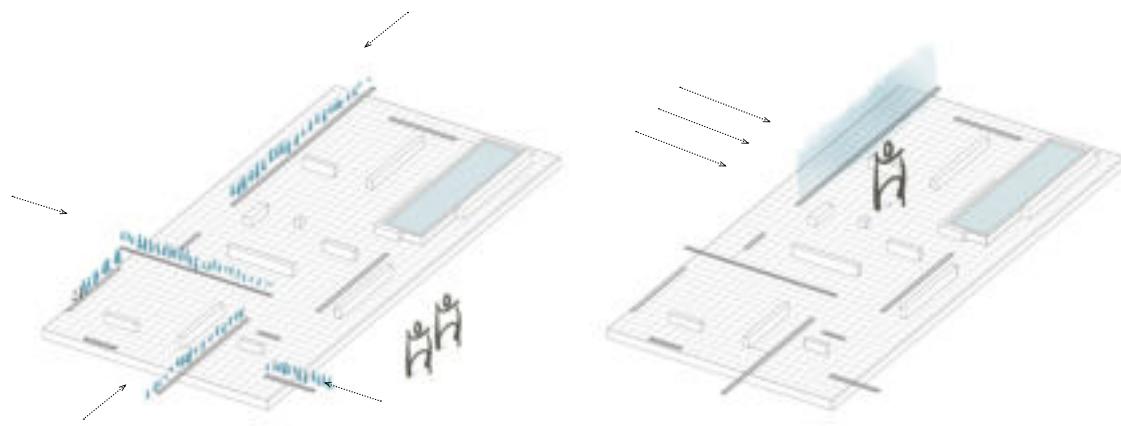
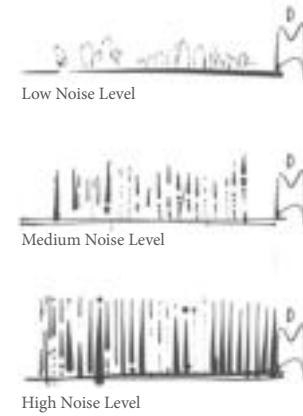




PERSONAL INTERACTION

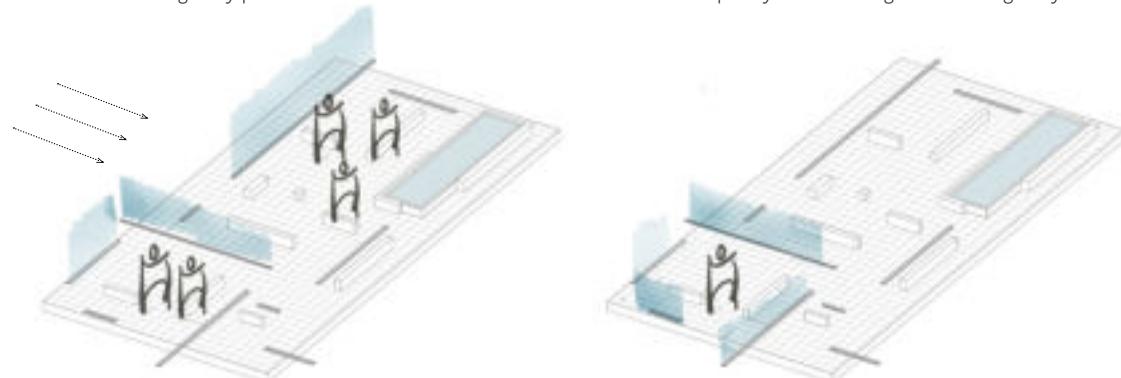
For the personal interactions, the feedback loop is rather simple: the height of the water spray is responsive to the surrounding noise level as well as human movements. The louder the noise is, the higher the water is. When there are no users on the plaza, the water is just gently activated to provide a white noise ambience for the surrounding environment. When a user comes and sits down, the camera will sense the

occupancy and the height of water will smoothly go up as the noise level increases. In this way, water is utilized in the most efficient way. When there are multiple users, the water is responsive to the noise level and divides spaces at different scales for multiple groups of users. The water plaza also corresponds with special requests from users to create customized spaces.



No User - The water is responsive to the surrounding environment and gently provides ambient white noise.

Single User - When the noise level increases, the camera senses occupancy and the height of water gently rises.



Multiple Users - The water divides space for multiple groups of users.

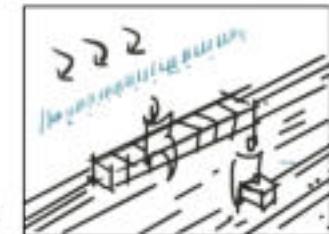
Special Request - The users could customize their space surrounded by water: private/open/semi-open.

There are two ways to interact with the water plaza. The first is providing ambient white noise for users. When people approach the plaza, the sound of water indicates the open spaces nearby and thus attracts people to walk towards it. When people arrive, they are able to find an ideal place by using the existed seating or combining urban furniture themselves. The water sprinkles gently to mask the surrounding noise. When the noise level goes up, the height of water also gradually increases. The continuous increase of the sound of water creates a noise barrier gently. The sprinklers are triggered by the changing direction of the sound. The second interaction corresponds to the users' need for crossing the space. The water curtain won't block the normal traffic. Since the camera will identify when people are within a certain distance, the sprinklers will stop automatically and make way for pedestrians.

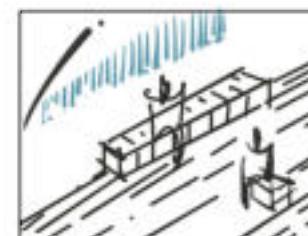
White Noise Ambiance



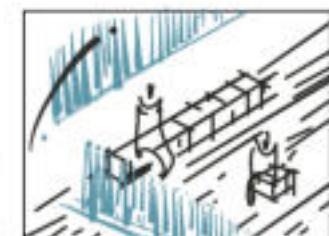
When people approach the plaza, the sound of water indicates open space and attracts people to walk towards it.



People could find their own ideal space in the plaza or combine the seating themselves, while the water sprinkles gently to mask the noise.



When the noise level goes up, the height of water also gradually goes up, the continuous increase in water sound creates noise barriers.



The sprinklers are triggered by the changing direction of the sound. The height of water keeps changing smoothly based on the noise level.

Crossing the Space



The water curtain won't block the normal traffic in open space. The camera will identify proximity.



If people approach within a certain distance to the water, the sprinklers will stop automatically to make space to pass through.



The view changes as water goes away, and some unexpected encounters will happen and make the space playful.



The water will be smoothly reactivated as the people reach a preset safe distance.

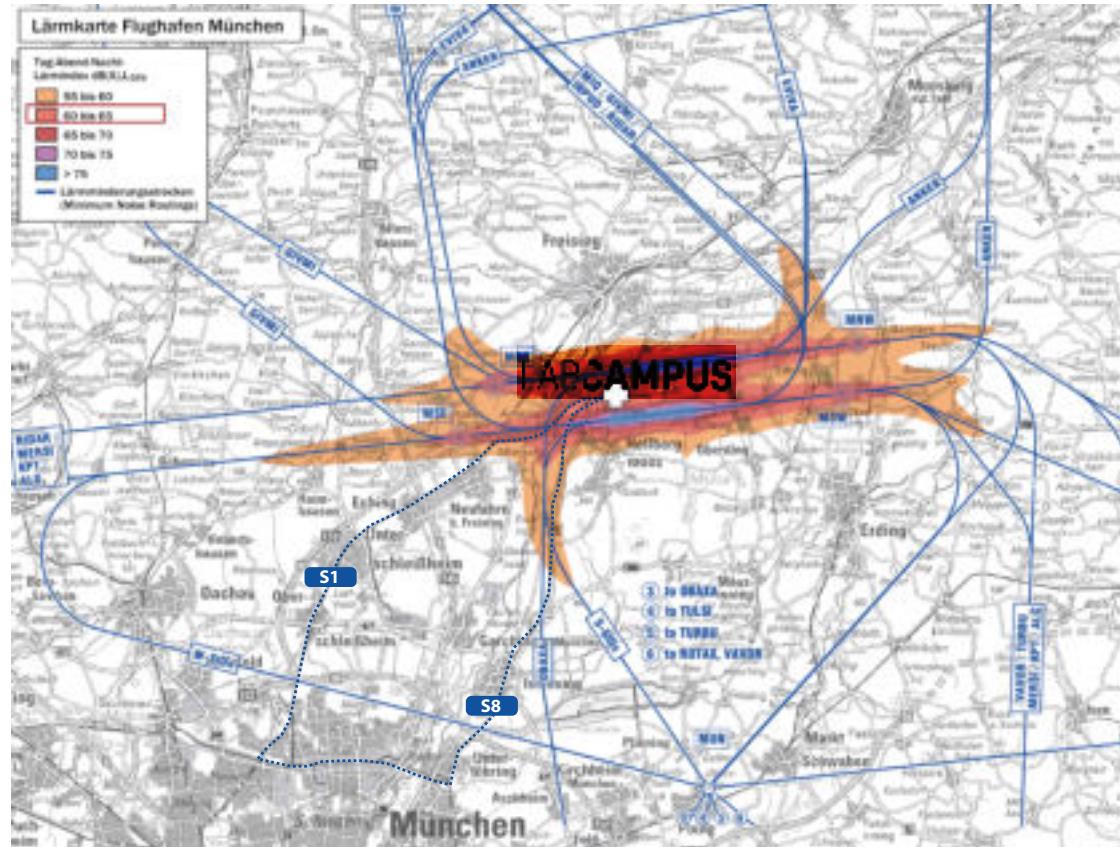
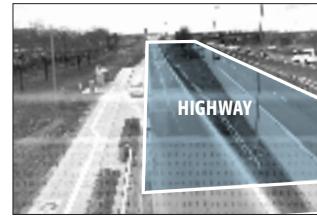
URBAN INTERACTIONS

Noise is one of the most crucial environmental elements of LabCampus because of its proximity to Munich Airport and traffic.

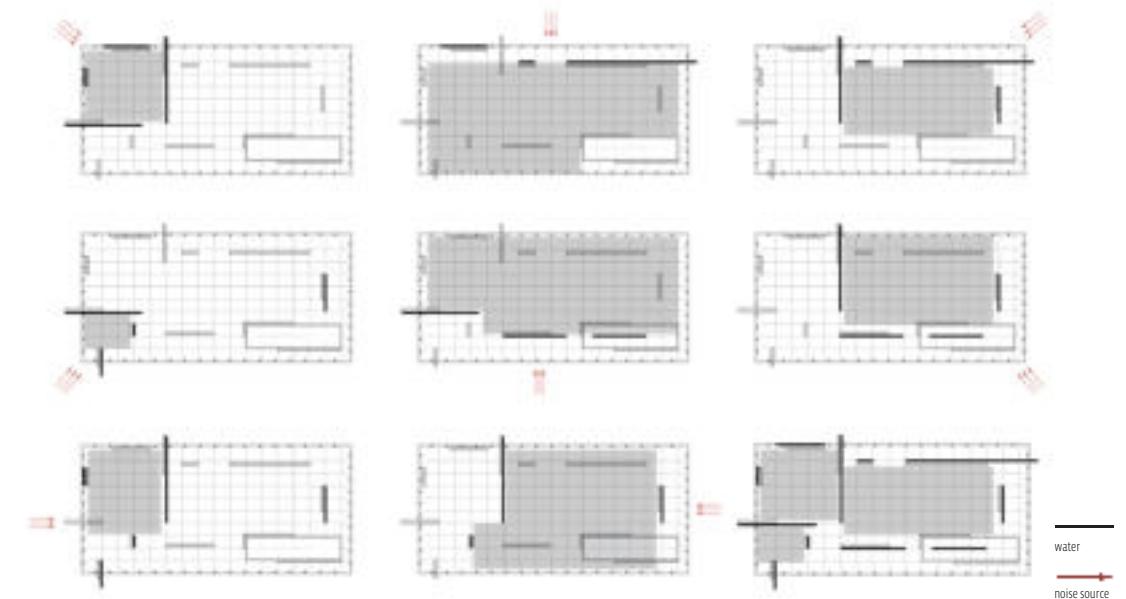
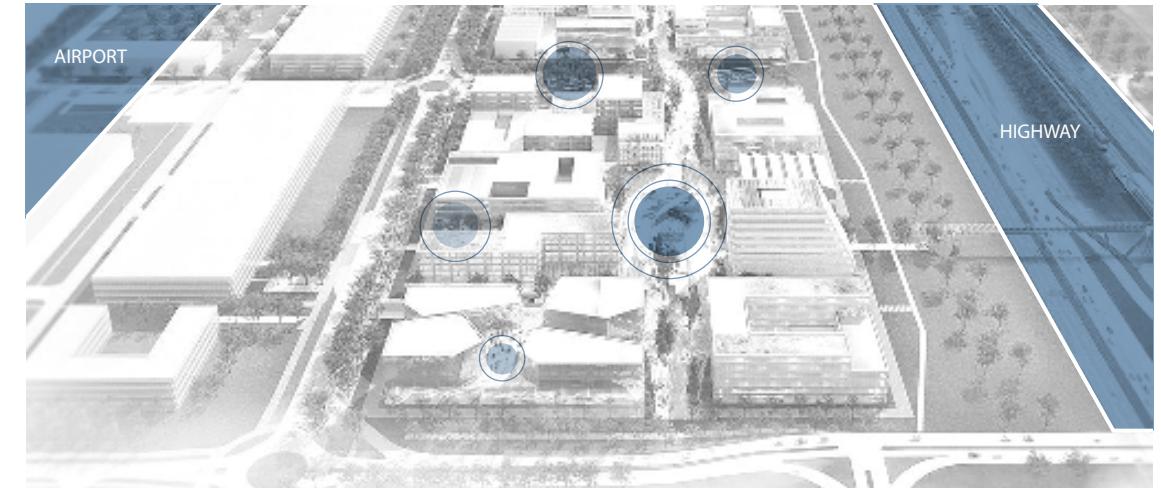
According to the noise map of the airport, the average noise level of LabCampus is around 60-65db, which is far above the comfortable threshold of human's daily life. The various existing flight routes make the noise influence the campus from all directions. But at the same time, the various flight activities bring LabCampus the lively vibrancy of

the airport. The water plaza aims to decode the noise from all levels and sources, celebrate it, and facilitate urban interactions. Noise is not a nuance anymore, it becomes a new medium of interaction which is responsive to our urban environment.

The potential sites for the water plaza are on the boulevard of the LabCampus, the public area between various office and retail buildings. The plaza could provide public spaces at multiple scales, from public gatherings to personal working.



Above: This work, "Noise condition of LabCampus", is a derivative of "Noise map for Munich Airport" by Alexrk2, which is licensed under CC BY-SA 3.0 <<https://creativecommons.org/licenses/by-sa/3.0/deed.en>> https://commons.wikimedia.org/wiki/File:L%C3%A4rmkarte_Flughafen_M%C3%BCnchen.png.



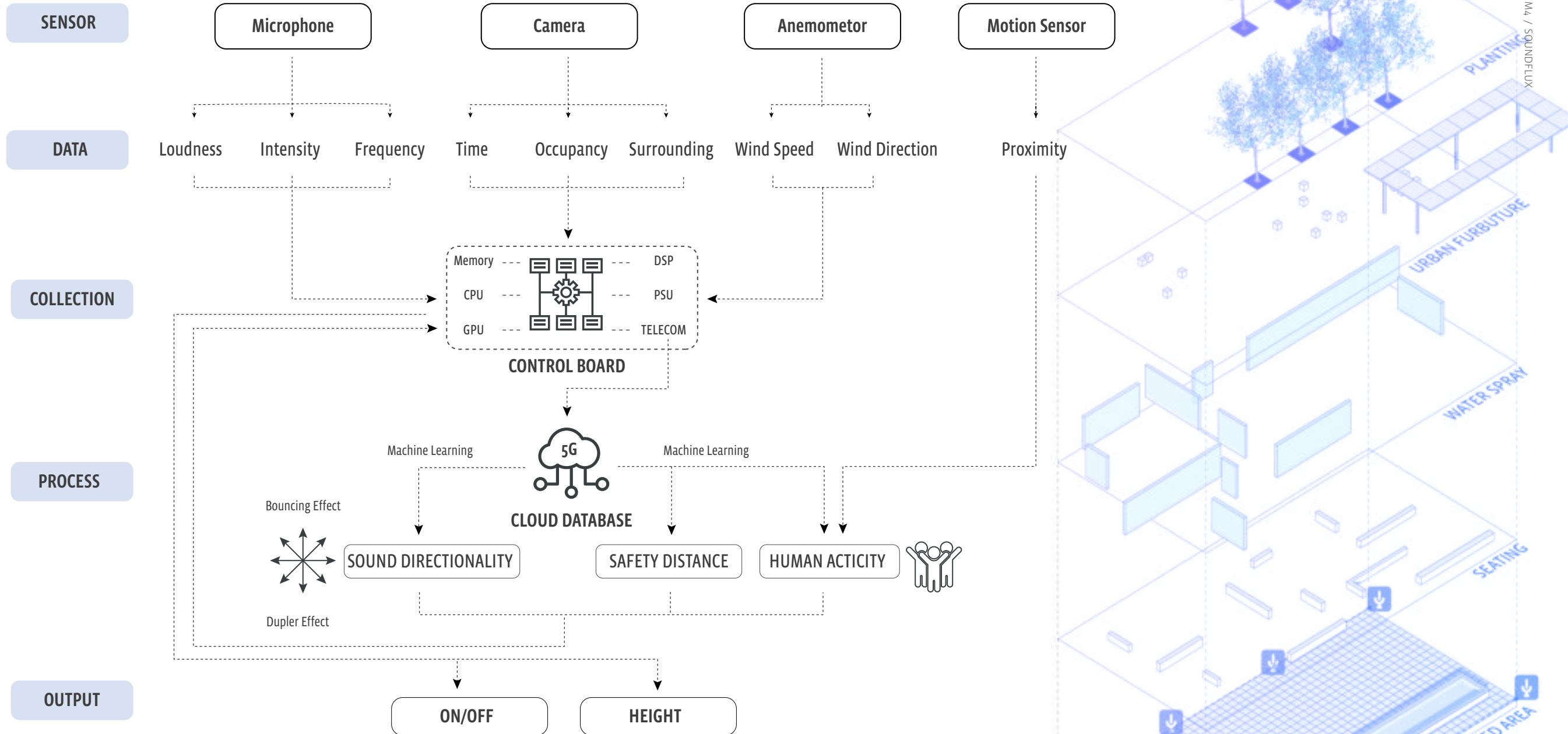
Based on the direction of the noise, human occupancy, and allocation of the water features, the space formed by the water keep changing. Sometimes, it forms private space which is surrounded all by water.

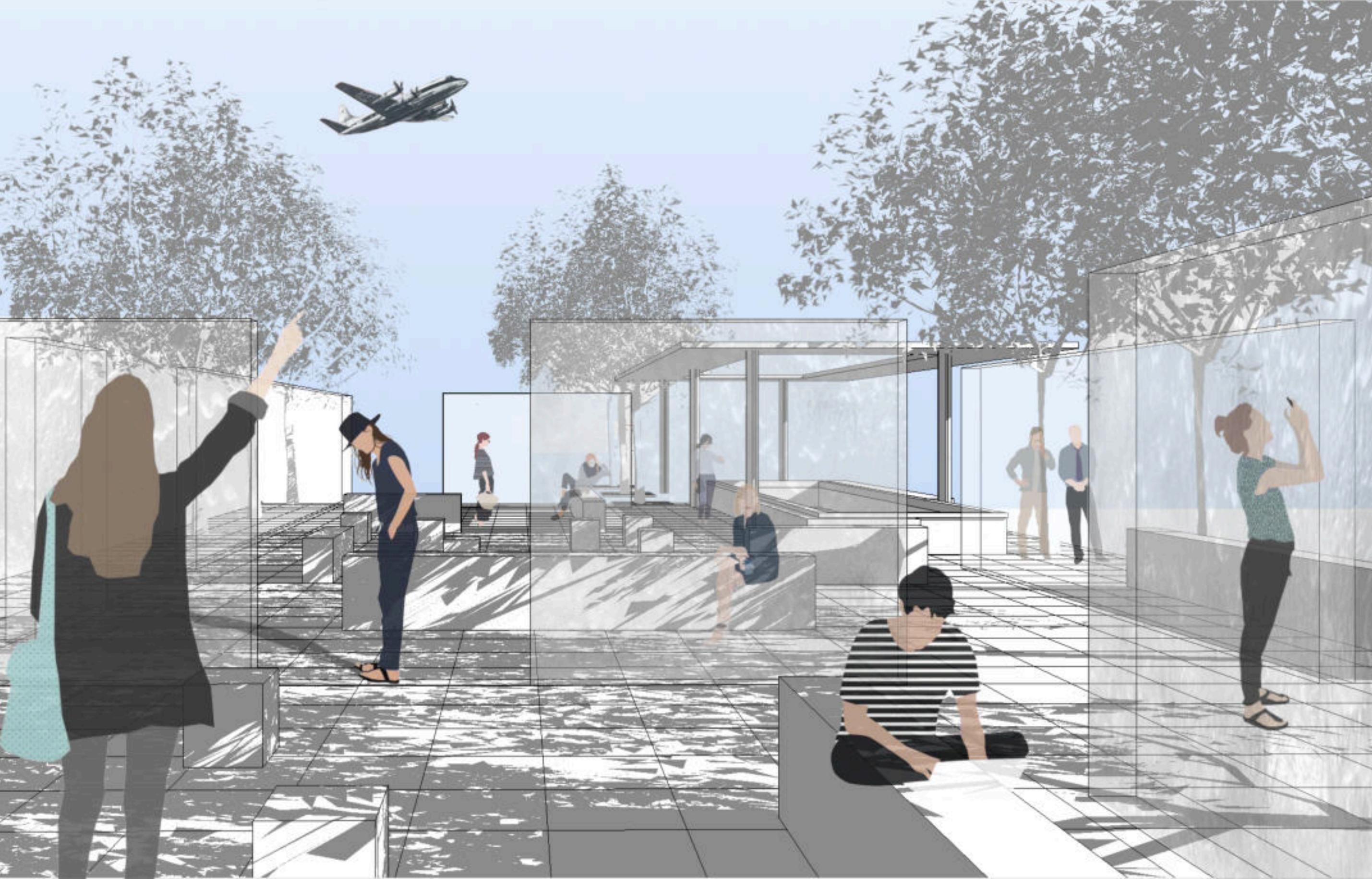
While sometimes the space is more open and welcoming, which is more suitable for a larger group gathering. When there is no occupancy, the whole place is quite open and keeps a continuous ambient white noise.

Above: Site condition and potential allocation of the project.

Below: Various scales of spaces formed by different noise sources.

TECHNOLOGY DESCRIPTION







ZHAODI WANG

Zhaodi is a current master student of Landscape Architecture at Harvard GSD. She holds a bachelor degree in Engineering from Beijing Forestry University majoring in Landscape Architecture. She worked in several design firms including Berger Partnership in Seattle, and the AECOM Beijing Office. She has a strong design background and experience in design research, landscape design, HCI, AR/VR, game design and so on. Currently, her research interest is gathering data from the surrounding environment and creating a more responsive urban experience.

M5

LabMUG

by Han Ning Tsai



SENSEABLE CITY LAB, MIT

PROJECT DESCRIPTION

LabCampus is a robust platform for fostering innovation in industry members, ranging from startups to international corporations. It provides a bold infrastructure for people to work. While the campus still needs further improvement to activate the outdoor open space, not only in order to provide micro-mobility solutions but also to provide a more vibrant human experience. How can we rethink the future innovation campus? And how can we bring 5,000 workers together as a creative community and leverage open space as a multifunctional platform?

The proposal is a series of smart mugs which connects business workers and facilitates a unique working lifestyle. Integrating the ideas of "Drinking and Networking", "Health Management", and "Match Making", the LabMUG is the social infrastructure for the campus. The ubiquitous Mug provides a continuous campus experience from indoors to outdoors. It can deliver an active street life, connect individuals from similar or different background through digital data and provoke human interactions.

The LabMUG invite office workers from the firms to dine together and utilize the lunch break for learning and sharing.

LabMUG consists of a plastic mug and a removable smart coaster. Users can log in their ID to through tapping the bottom coaster. Users are able to create a profile with sharable interests or other data and social media links for the app. Moreover, the mug also serves as an apparatus for mapping the social dynamics of the campus. The mug can calculate the consumption of the beer, the diversity and quantity of human interaction, while geo-locating these activities on the campus.

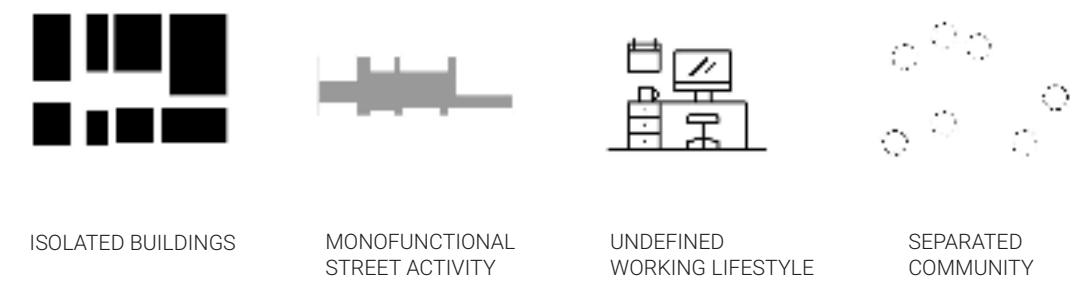
The LabMUG can easily be distributed and charged in office spaces, the canteen, and several outdoor dining hubs. The proposal is inspired by the Bavarian beer garden culture and reimagines drinking lifestyle with embedded technology.

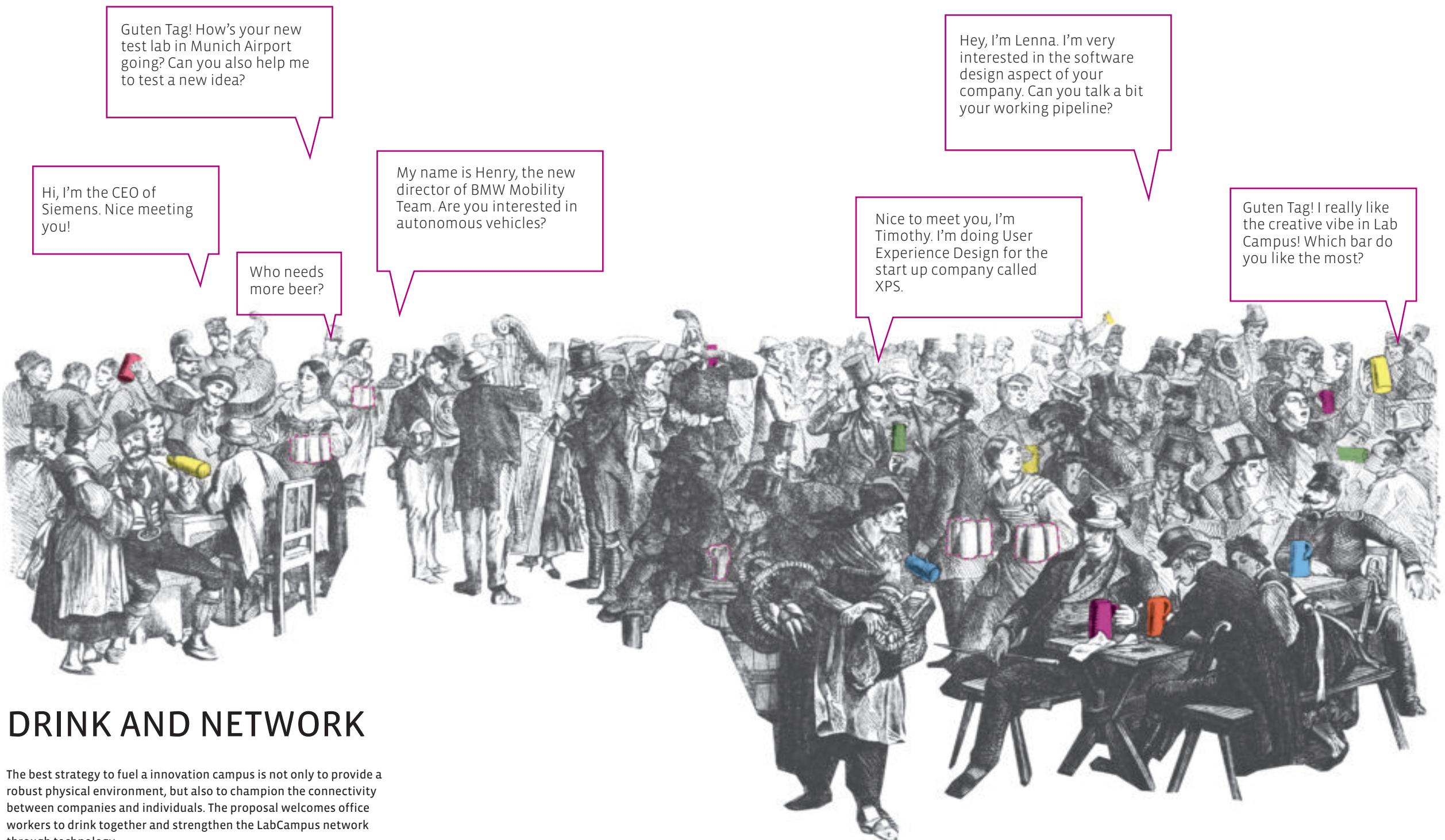
LabMUG will fuel creativity and connectivity in the community.

The LabMUG can further the identity of LabCampus while having a

practical use. It provides a drinking plan for hydration and helps office meetings become more engaging through survey and Q&A features. It creates a feedback loop of human interaction data. LabCampus can improve the physical environment and the commercial service for the users using this data. But most importantly, LabMUG encourages healthy drinking and informal meetings.

Right: Social Interaction Improvement Strategy







PERSONAL INTERACTION

The product can also be used during lunch and dinner time for employees and employers in LabCampus to increase the possibility for people to mingle and exchange information. The first basic function that will be performed will be the notification system that send out signals when a mug needs to be refilled.

Secondly, the combination of the smart coaster can be used as a media that pairs people with similar professional backgrounds or interests. For instance, the LED light

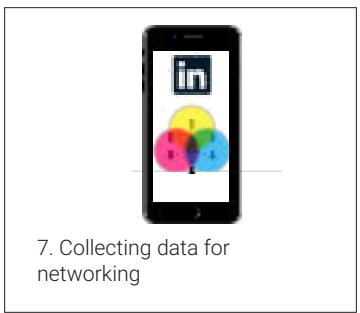
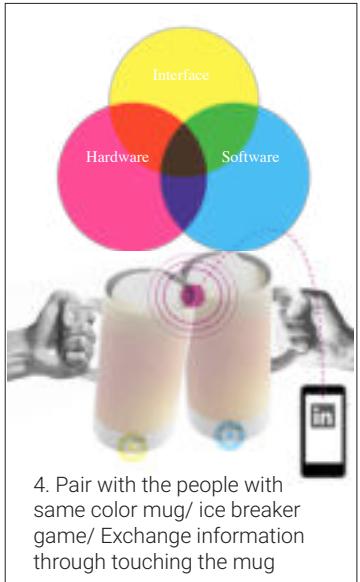
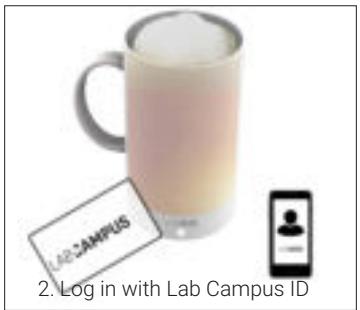
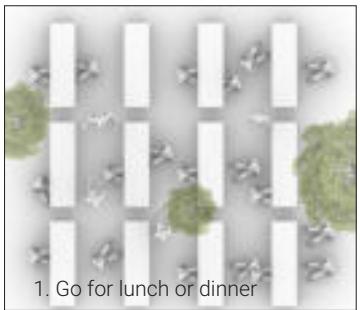
with three colors presents people's professional backgrounds. The blue represents software industry, the red represents hardware industry, and the yellow represents interface design. This product will also be part of an ice breaker game and help users to exchange professional and personal information through the touch of two devices.

Office water drinking plan



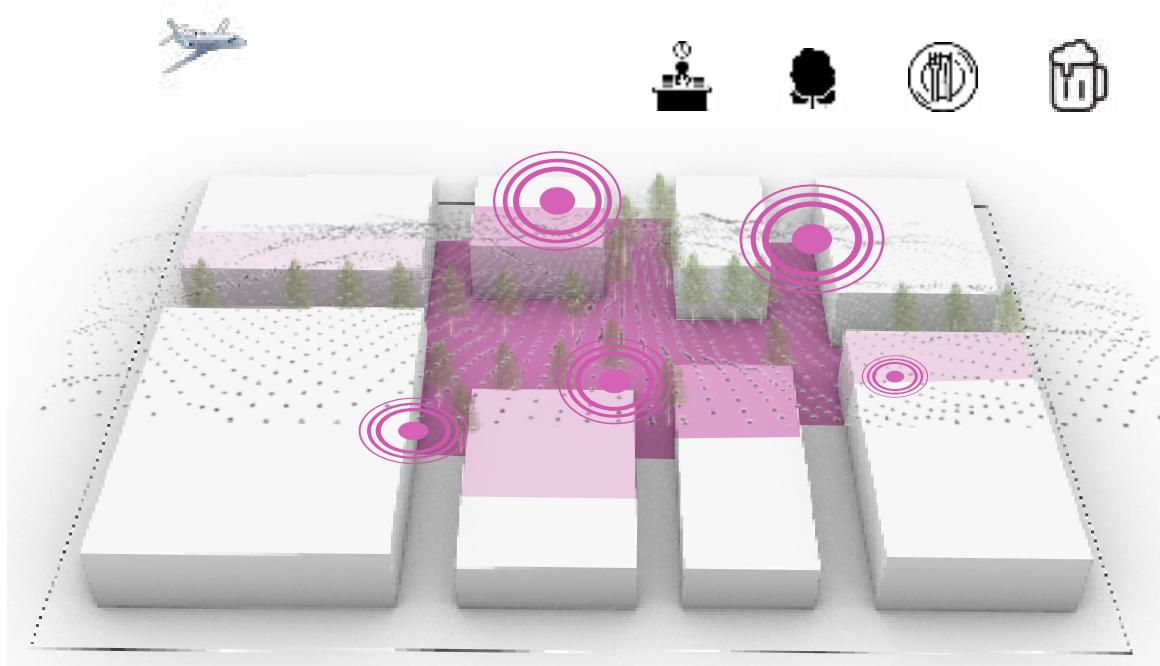
Office meeting mediator:
Survey/ Q&A

Working Mode
(in Office)



Agree 14
Not Agree 10

LabMUG can operate as meeting mediator and match maker on and off work.



LABCAMPUS

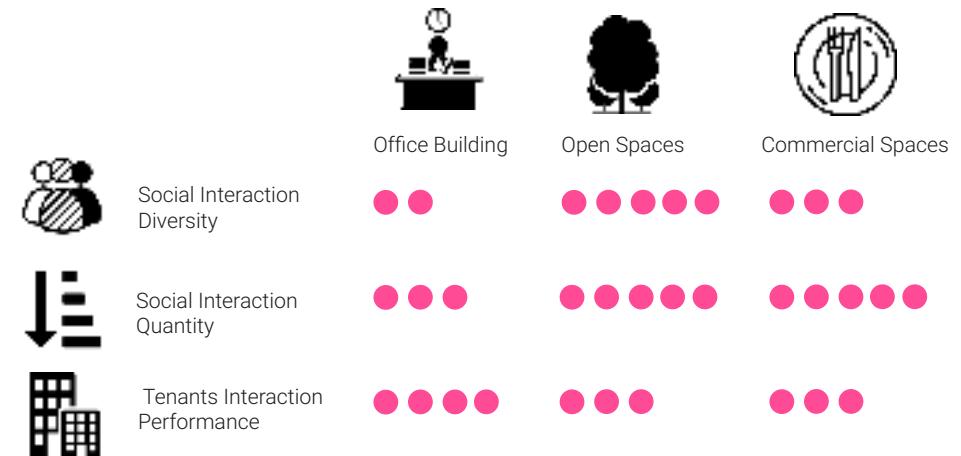
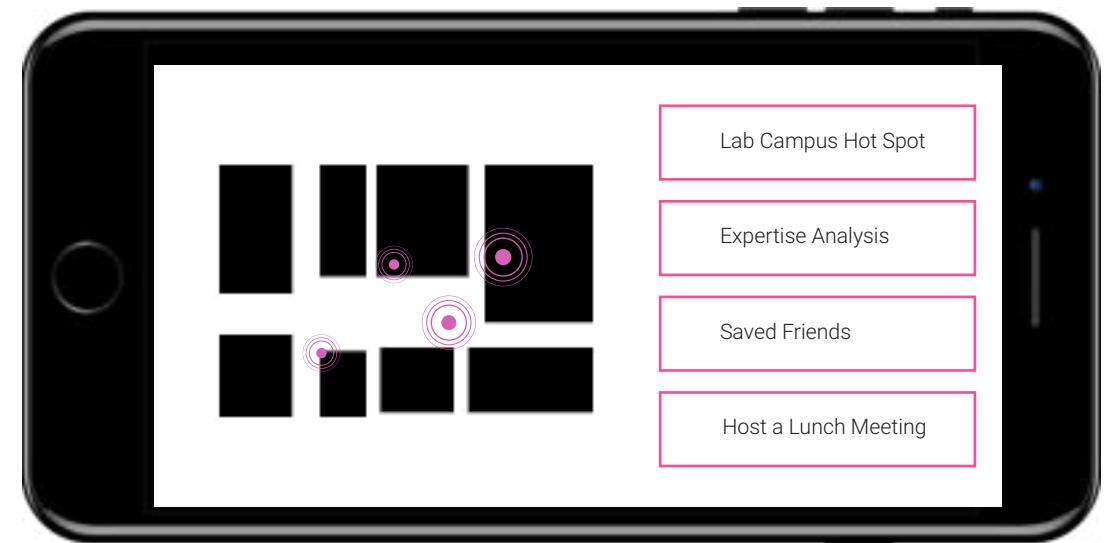
URBAN INTERACTIONS

The collected data can be divided into different components: the Diversity, the Quantity, and the Tenants. This data can all be layered with location information generated by the Bluetooth devices. Thus the users

and the LabCampus company can sense the most updated status of how people interact and the usage of different spaces on campus. It provides real-time guidelines for people of different expertise and

interests to network with the people they want. On the other hand through the locative data, LabCampus can improve their operation in terms of their service, the selection of retail, as well as the quality of the outdoor open space. Together the data can further overlap with the current micro mobility data, in order to achieve a more responsive and smart innovation campus.

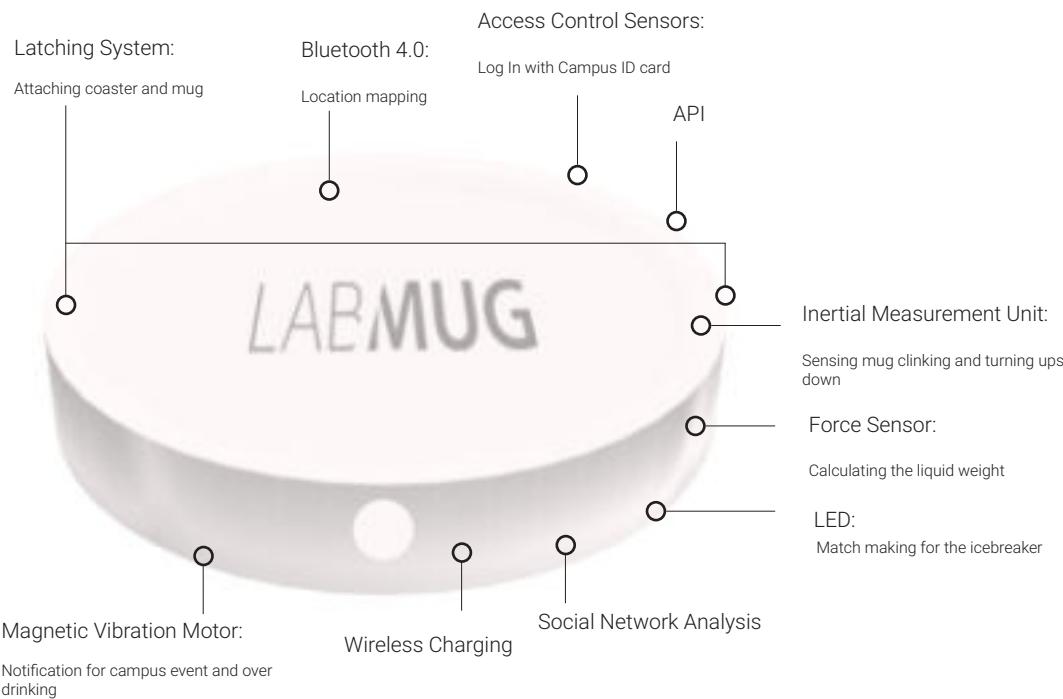
LabMUG system can help map out the social dynamic map of Lab Campus.



TECHNOLOGY DESCRIPTION

The main technological feature of the LabMUG is essentially embedded in the coaster part, which consists of IMU, force sensor, Bluetooth LED, Vibration Motor, LED, and a latching system. Together these sensors enable the Mug to sense the motion of the user's gesture and the weight of the drinks. Most importantly it synchronizes with a cloud storage system and the user's personal smartphone. It actuates different outputs which create a robust social network for the campus workers, and also trigger future urban interactions between new people.

In terms of the exchanged data set, all the data collected through the smart coaster and mug will be transferred to user's personal device.



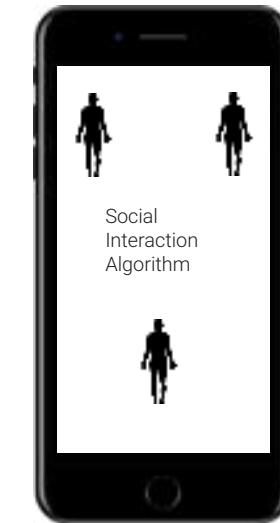
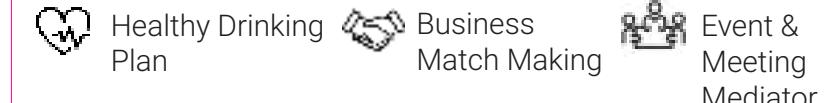
LabMUG consists of a plastic mug and a removable smart coaster.

The information will include the data that is collected for networking, the data for personal health control, and the notification future networking possibilities. Another use of this mug is to transform the system into a device that helps office to hold surveys in a meeting. It's convenient for its user to send out their preference through this device.

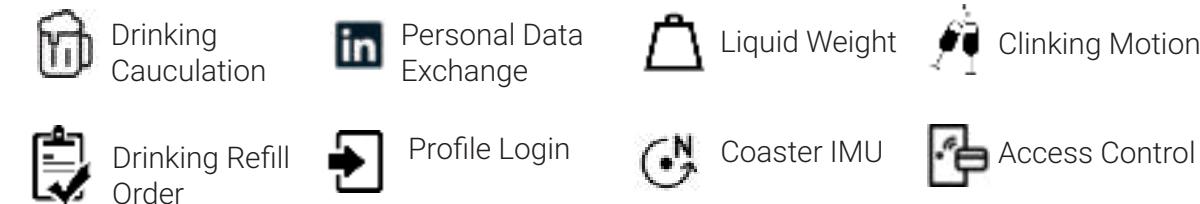
Data Processing (Cloud System)



Output & Service



Actuating



Sensors (Smart Coaster)



HAN NING TSAI

Han Ning is currently a first year Master of Architecture in Urban Design Candidate from Harvard GSD, with 2 years urban design practice in AECOM Shanghai. Dealing with new town development and TOD urban design project. Han Ning obtained an Architecture bachelor degree in Taiwan, National Cheng Kung University. He has strong passion for exploring new mobility for the future cities and interested in shaping the built environment using technology.