A SENSITIVE WALL

A dynamic green noise barrier installation for façade
We are a startup focusing on sustainable and eco-friendly solutions for urban life. Combining architectural design, product design and biomimicry, we aim to promote a lifestyle following the UN SDGs.
A Sensitive Wall

A Sensitive Wall is a sustainable and efficient noise proof and shading installation for buildings' exterior walls. A Sensitive Wall solves the urban noise and energy consumption problems. It is also an attractive and eco-friendly dynamic choice for façade.
Transportation construction is an indispensable infrastructure for cities, but with the development of cities and the increase in traffic, traffic noise also causes problems for people living in cities.

The operation of the Taoyuan Airport MRT and the completion of the ring line have brought convenience to most people, but for the residents along the line, the temporary noise generated by the trains has become their new worries.
Facing the noise, animals have different methods to prevent from hearing loss. Concave-eared torrent frog close its normally open Eustachian tubes to modulate the sound level. That inspired us to design an automatic system that reacts to the noise.

Green noise barrier is an emerging urban sound insulation technology, and many studies supported its feasibility. The branches and leaves can block, absorb, and resonate higher frequency noise, while the planting container and substrate can cope with lower frequency noise. We designed a dynamic green noise barrier responding to noise.
We designed a green wall composed with rotatable pot units which can respond to environmental changes. Form, material, and color of the pot unit were inspired by the desert snail, which adapts to a hot and dry environment. The egg-shape pot was made of fiber reinforced plastic (FRP) to make it light and strong. The curved surface helps to reflect radiation and reduce evaporation. The funnel-shape bottom saves water for irrigation by draining the excess water to the lower pots.

The “Sensitive” Wall
We put the receiver-actuator-deformation system and two coexisting sets of stimulative mechanisms into the green noise barrier wall system.

**When the receptor is stimulated tactilely and thermally, the expansion pressure of the tertiary pulvini (actuator) allows the mimosa to close its leaves in a short time and maintain for 2-10 minutes. At the same time, the receptors on the leaves can also be stimulated by light and run on a daily cycle. Through the change of the turgor pressure of the second pulvini, they close the leaf at night and open again after sunrise.**

**Biomimicry System**

We put the receiver-actuator-deformation system and two coexisting sets of stimulative mechanisms into the green noise barrier wall system.

Two Movement of Mimosa Pudica
The rotation system is like mimosa responding to different environmental changes.

Normally, the pots rotate following the angle of sunlight for the best sunlight receiving. When excessive noise is detected, the pots rotate to the best noise-blocking angle. After the noise is eased, pots return to the previous angle and follow the sun again.
We built a 3D model at a real site in New Taipei City in Taiwan and put it into the acoustic analysis software to test the Sound Pressure Level (SPL) before and after the installation of our design. With the linear sound source setting to 80 dB and the distance from the MRT rail to the building set to 6.5m, we get a 2-6 dB reduction (Maximum 75% of sound energy reduction) of the SPL.
The green noise barrier system also reduces the direct solar exposure of the building envelope, thereby reducing the energy consumption of interior. Without this green barrier, the annual solar radiation absorption is 10378.29 kWh/m$^2$. After installing the green barrier, the direct solar radiation is reduced by 61.3% annually at the 0 degree. At 45 degrees, 59.8% of the solar radiation is reduced. At 90 degrees, 57.7% of the solar radiation is reduced.

Sun Light Simulation

The green noise barrier system also reduces the direct solar exposure of the building envelope, thereby reducing the energy consumption of interior. Without this green barrier, the annual solar radiation absorption is 10378.29 kWh/m$^2$. After installing the green barrier, the direct solar radiation is reduced by 61.3% annually at the 0 degree. At 45 degrees, 59.8% of the solar radiation is reduced. At 90 degrees, 57.7% of the solar radiation is reduced.
Indoor Natural Light Control – App & Personal Preference

The rotation can also be controlled through personal devices for better natural light adjustment of indoor spaces. The dwellers can check the energy and noise statistic information in the App and the prediction of the influence after their adjustment so they can find the perfect balance between personal preference and energy/noise benefit provided by the Sensitive Wall.
Rainwater is collected and stored for irrigation. Timer is set to irrigate and fertilize at certain times automatically. Water can drip through the drainage hole on the bottom of the pot to the lower pot on the both sides.
Adaption of Nature’s Unifying Patterns

The Sensitive Wall runs on information.
The main concept of the wall is to collect environmental information through sensors and respond to them.

The Sensitive Wall is locally attuned and responsive.
The wall was designed for tropical urban area to solve the problem caused by human activities and local climate. All the analyses were set in the real conditions of a building in New Taipei City to check its feasibility.

The Sensitive Wall uses shape to determine functionality.
The shape, color and material of pot unit were chosen for reflection, durability and evaporation reduction.

The Sensitive Wall is resilient to disturbances.
To face the most common disaster in Taiwan, typhoon, we kept the strategies of lightweight and simplicity when designed the wall system to prevent damage and hurting pedestrians.

The Sensitive Wall provides mutual benefits.
The sensitive wall provides better interior environment for attached building. It also plays an ecofriendly role in the urban space by reducing heat island effect and providing additional greenery.
Business Model

Supply Oriented
- AIoT Integration company
- Dr. Shu Minwu Zhao - Botanist from Academia Sinica
- AGRIFORMATION, CO., LTD - AI Integrated farming technology company
- CEINCO, CO., LTD - Environmental Friendly container rental company
- Dr. Hung Wen Tsai - Patent consultant
- Dr. Hui-Chih Wang - Commercial consultant
- Biomimicry Institute
- National Taiwan University of Science and Technology

1. Product sales and fee for service at the beginning (B2C)
2. Licensing in the future (B2B2C)
3. Award-winning team
4. Experienced designers with material development and acoustic background.
5. Our international consultant team covers multiple fields from botany, mechanical engineering, construction and marketing.

Key Activities
- AIoT system
- Sensor testing
- Rotation mechanism demo
- Prototype building
- Interactive APP device and UI
- Marketing

Key Resources
- 1st stage: 483 USD (Prototype)
- 2nd stage: 10000 USD (Detail and workable)
- Marketing cost: 10000 USD
- Researcher consulting fee: 10000 USD

Cost Structure

Key Partners

Business model design

Customer Relationship
- Market developing section
- Online sales
- Offline sales
- School sharing section

Customer Segment
- B2B Business that embraces new green technology and creates environmental value.
- Schools
- Government

Value Oriented
- 1. Environmental friendly
- Noise control
- Sun proofing
- Green coverage
- Biomimicry design

2. Technology based
- AIoT system network
- Green education

Value Propositions

Revenue Streams
- Competition prize
- Investors
- Government grant
- 10000 USD
- 10000 USD

Financial Oriented
Master in Architecture
- National Cheng Kung University

Ph. D student
- National Taiwan University of Science and Technology LEED AP BD+C

Speciality
- Architecture acoustic
- Performance architecture
- Parametric design
- Sustainable design

Works
- 2019 National Tsing Hua University music department performance hall renovation
- 2019 Academia Sinica conference hall
- 2019 National Chiao Tung University Music performance hall renovation

Team Member

Hungyi Lai
Ph. D student
- National Taiwan University of Science and Technology LEED AP BD+C

Speciality
- Architecture acoustic
- Performance architecture
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Works
- 2019 National Tsing Hua University music department performance hall renovation
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- 2019 National Chiao Tung University Music performance hall renovation

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experienced superintendent

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digital fabrication/parametric design

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Hong Yijin
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Tang Ruojun
licensed architect

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Eve Chiang
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