THE GLASGOW SCHOOL OF ART

University of Glasgow

PLANTA

PLANT HOUSEKEEPER

THE APPLICATION OF PLANT IN SMART HOME

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Overview & Content

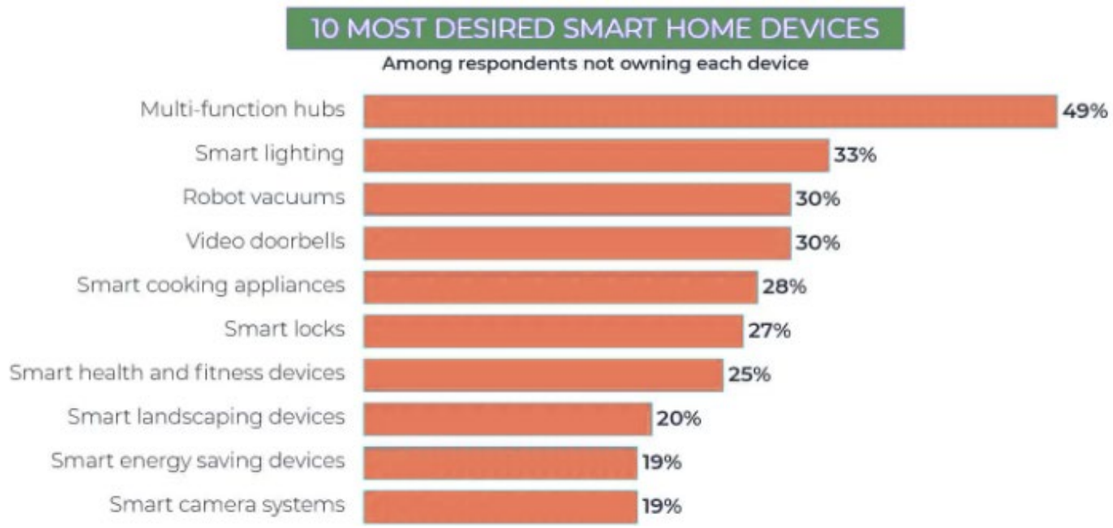
PLANTA, use plants in the smart home system as sensors and controllers, acting as housekeepers to help the user control appliances at home to provide a more comfortable, natural and vibrant environment and reduce the cold and mechanical feel that comes with home intelligence.

Problem

Smart home makes people's lives easier, but it also leaves people in a home that is supposed to be warm but often dealing with mobile phones and tablets, controlling everything in the home mechanically, which takes away a lot of the original human experience and feeling. As a result, it creates a strong sense of distance and coldness in people toward smart home[3].

Therefore, **the question of how to make the smart home more vivid and get closer to nature while providing convenience to the user** is the concern of this project.

Common Smart Home Products and How They Operate



Key differences from traditional homes:
Remote sensing and control

Common modes of operation and use:
Operation via smart products such as mobile phones and tablets
Voice control
Operating panels

Smart Home Market Analyse

Based on the products available and how they operate, as well as market reports such as Forbes ADVISOR, it is clear that:

Convenience is the functional need of the moment:
The current smart home market is still in the pre-development stage. This is because the current products intelligently meet the more basic and simple functions, such as remote switches, wireless switches, etc. And the diverse communication protocols have not yet been unified, raising the threshold for new users. Therefore the current demand for smart home is still in the early stage of functional demand, like convenient and time-saving.

Emotional needs are the future:
However, with the development of technology and market, after reaching the middle and late stage, the functional needs are satisfied and consumers will have emotional needs. So emotional needs will be the future development trend of smart home, for example, voice assistant, textile materials of Google Home are the initial satisfaction of this demand.

The product is therefore aimed at the market in 8-10 years.

Explore Directions

The project will explore **the application of plants in the smart home** sector, thus solving problems and making the smart home closer to nature, to the original human instincts, more alive and warmer.

Reasons for plant:

1. Vivid and vital. The most common life form in the home apart from humans and more controllable than pets.

2. Innate sensing and responsing abilities.

3. Close to original human experience and sensation. Humans have a long history of using plants.

4. Subjective thermal comfort like humans

Some Existing Explorations and Products

As Sensors

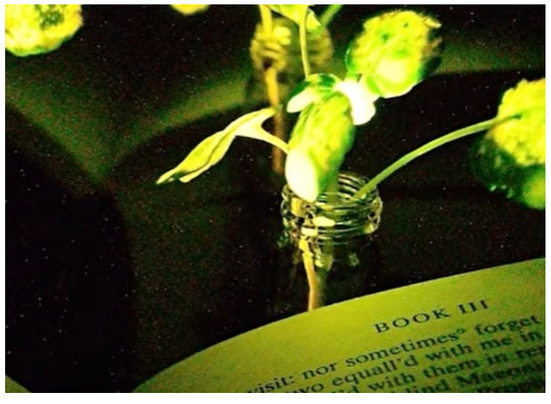
Elowan
Plant robot that moves according to the direction of the light

As Actuator

Remote-controlled Venus Flytraps
Be controlled using signals sent via a smartphone

As Controller

Control the closure of the flytrap by touching the mimosa

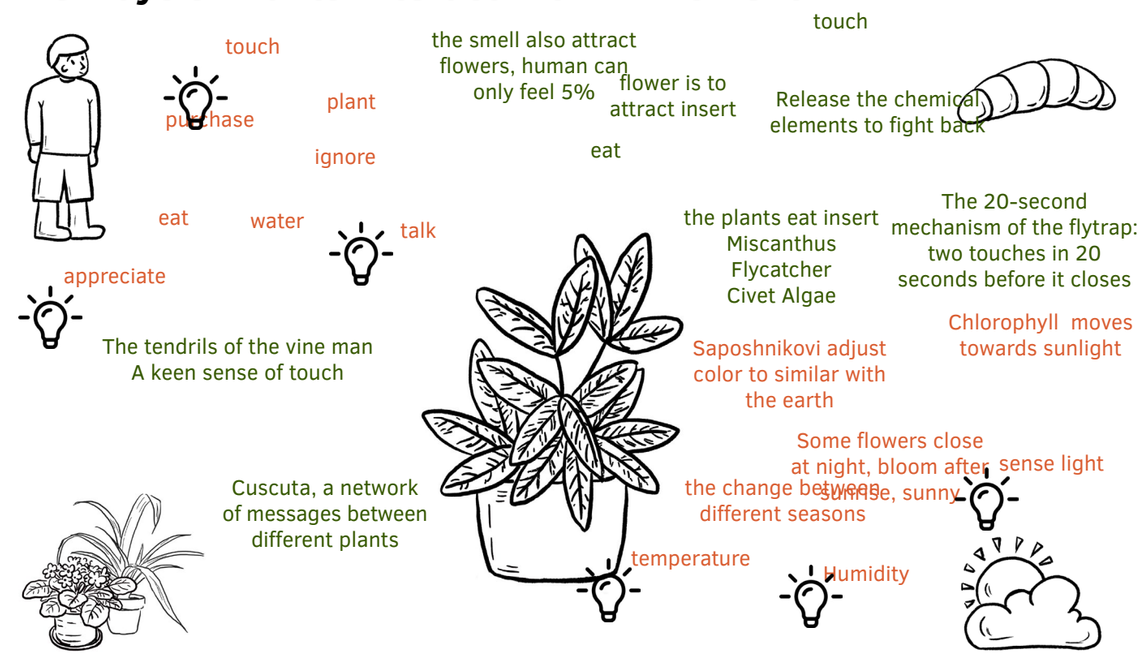


External Substances

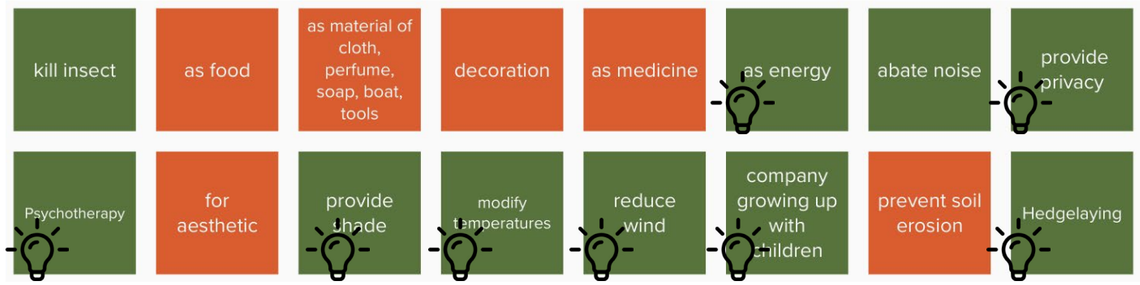
Glow-in-the-dark Plants
Embed specialised nanoparticles into the leaves of a watercress plant

Brainstorming

The Ways of Plants Interact with Enviroment



How people use plants



Oppotunities

Target Users

The target audience for this project is **plant lovers**.
It will also appeal to the Early Adopters and Impressers groups, based on the smart home market's classification of consumers and the innovative nature of this product.
But the focus remains on plant lovers.

Common characteristics:

Treat plants as a living being/pets
like to interact with plants (touch, talk, praise),
care about plants' growth,
can easily identify the state of the plant.

Needs:

Want to have more interaction
want the plant to be a system and not a single plant,
Sometimes practical

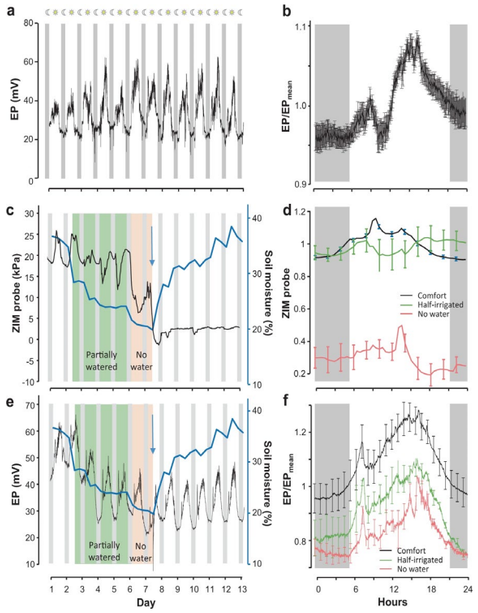
"I think the first one is great. But can plants really meet such requirements?"

"The first one may be combined with other function, become a system, including multiple functions."

according to target users' feedback

Plant Signal Detection Technology

Different solutions exist to detect signals from live plants in real time. These include carbon nanotube sensors, PCR techniques, etc. Considering that the product will be used at home by the average user, **detecting trace electrical signals** from plants is the most appropriate way to do this as it does not require expensive instruments and a rigorous detection environment.



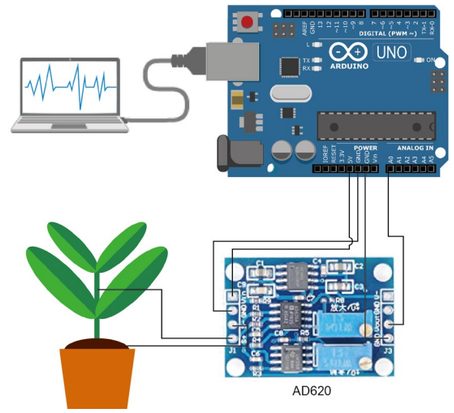
The technology is now available from the Swiss company Vivent.

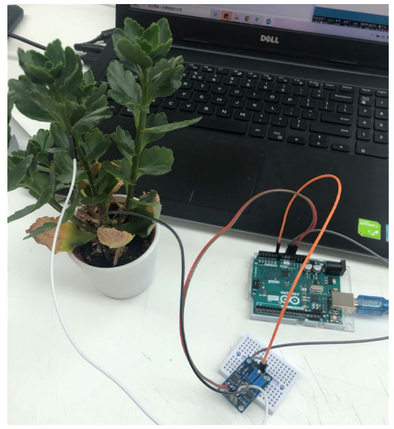
The electrodes of the PhytlSigns device consist of a coaxial cable; the central conductor (silver coated copper wire) wire is inserted into the leaf stalk. And it uses supervised machine learning techniques to identify and analyse plant states using the acquired electrical signals.

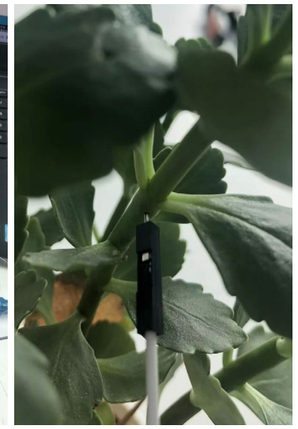
With the PhytlSigns device, the state of the plant under different external conditions such as moisture, touch, spider mites infestation, drought, nutrient deficit, iron deficiency can be identified. It can also record changes in the plant in a 24-hour cycle.

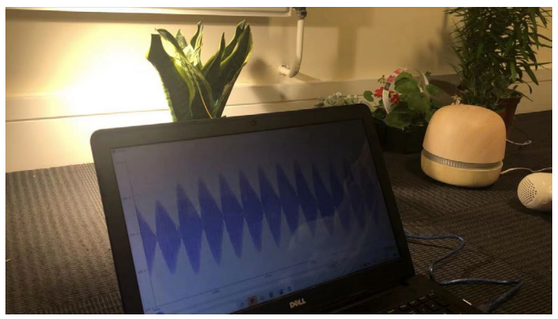
Plant electrical signal detection test

As Vivent equipment is limited and not available, I conducted my own experiments to test the feasibility.
The test was carried out using the Arduino kit and platform and the AD620 on different plants under different independent variables. The circuit is shown below.

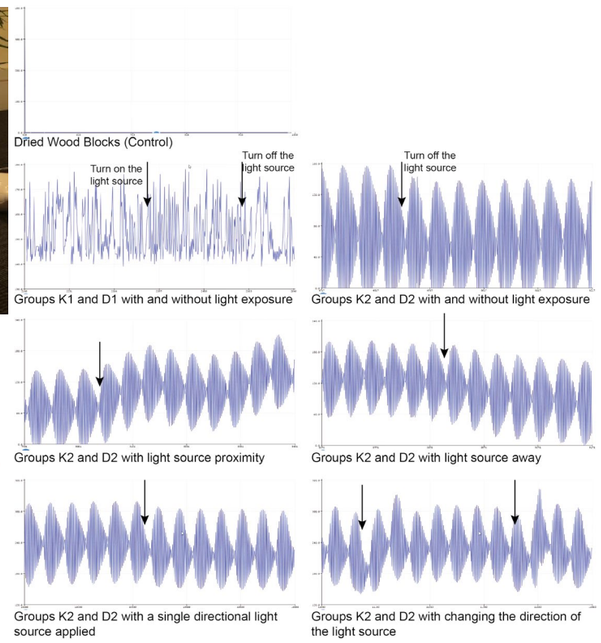








The result suggest that it is feasible to understand environmental factors and plants' status by detecting and analysing electrical signals.



Existing Thermal Products

Google Nest Learning Thermostat

Honeywell Home T5 Thermostat

Ecobee SmartThermostat

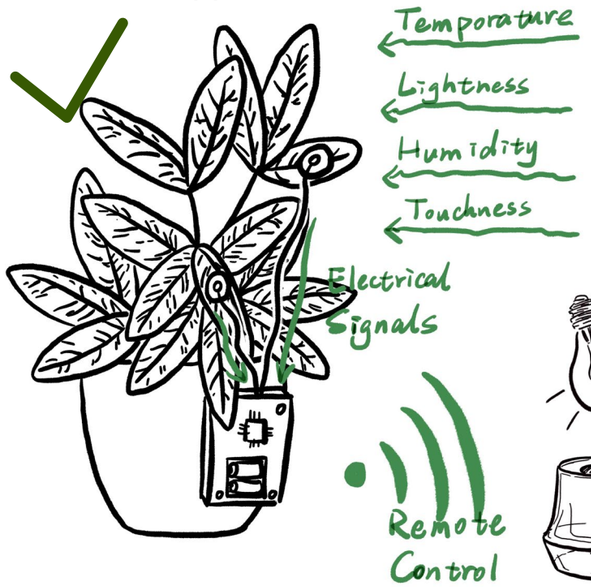
Mysa Smart Thermostat

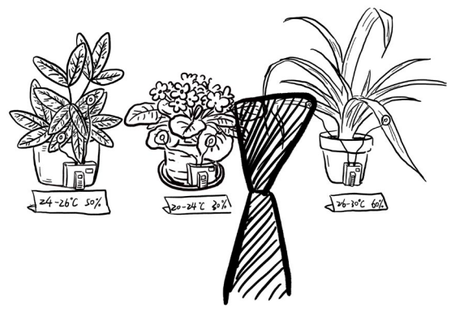
Except for the NEST, which is only controlled by a panel and a wireless remote control using a mobile phone, it is not really smart.
Although Nest learns the user's routine, it cannot react to "unexpected situations" and cannot sense the difference between subjective and objective human temperatures.

Concepts and Evaluation

Based on the brainstorming and user interviews, three main directions of development were identified as possible.

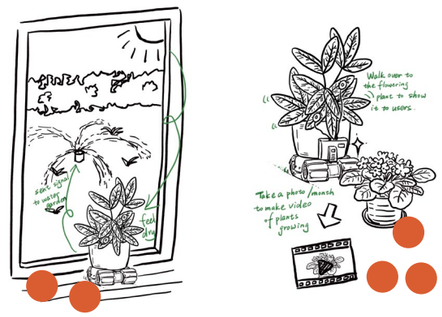
1. Control appliances at home





3. Connect with other plants

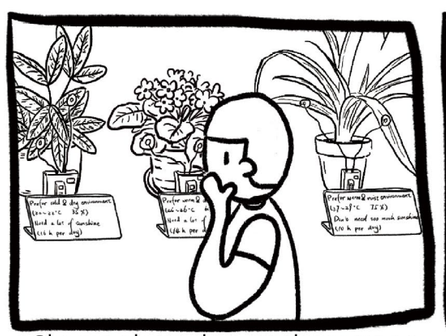
2. Ways of conveying information and interaction



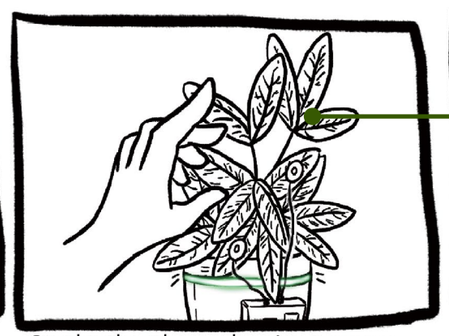
The project will be based on the functional location of the first direction, complemented by the second, and the third will be established as a future functional iteration. The options were also selected based on user feedback.

Initial Storyboard

The project will use thermostat as a core function, movement and light as a way to interact and convey information, with storyboards to consider functional details and technical requirements.

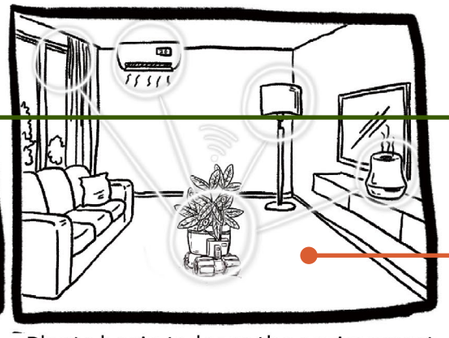


Choose plants that are the same as your environmental preferences

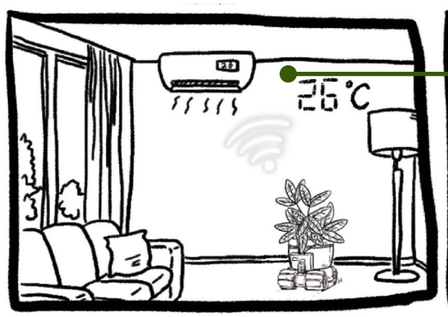


Stroke the plant, glow in response

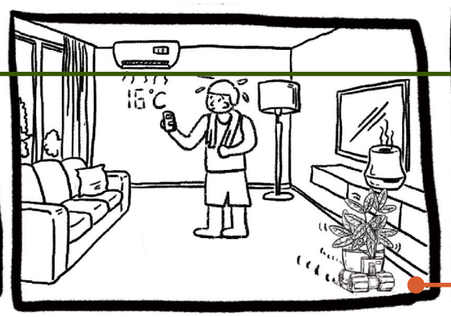
Take home the product



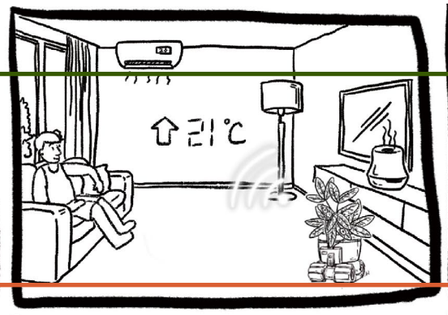
Plants begin to learn the environment and control appliances at home



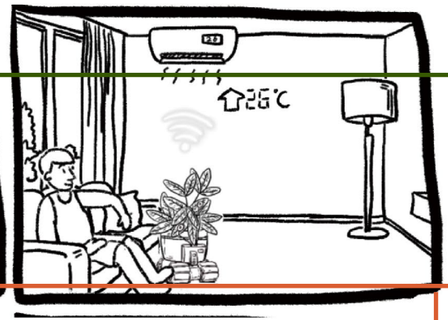
Most of the time maintain the temperature at a healthy level according to your preference



When you have finished exercising, you adjust the air conditioning to a lower temperature



The plant feels unhappy and slowly adjusts the temperature back to its original one secretly



It may seem like the plant is doing this for itself, but it's actually helping you stay healthy at the same time

In the morning, the plant senses its need for photosynthesis

Plants control the opening of the curtains and also wake you up with sunlight

Plants move into the sunlight

Technical Needs

Sense the touch

Wireless control of appliances (air conditioners, humidifiers, lights)

Feel the temperature (body temperature) (Accuracy. Threshold of temperature difference)

Movable

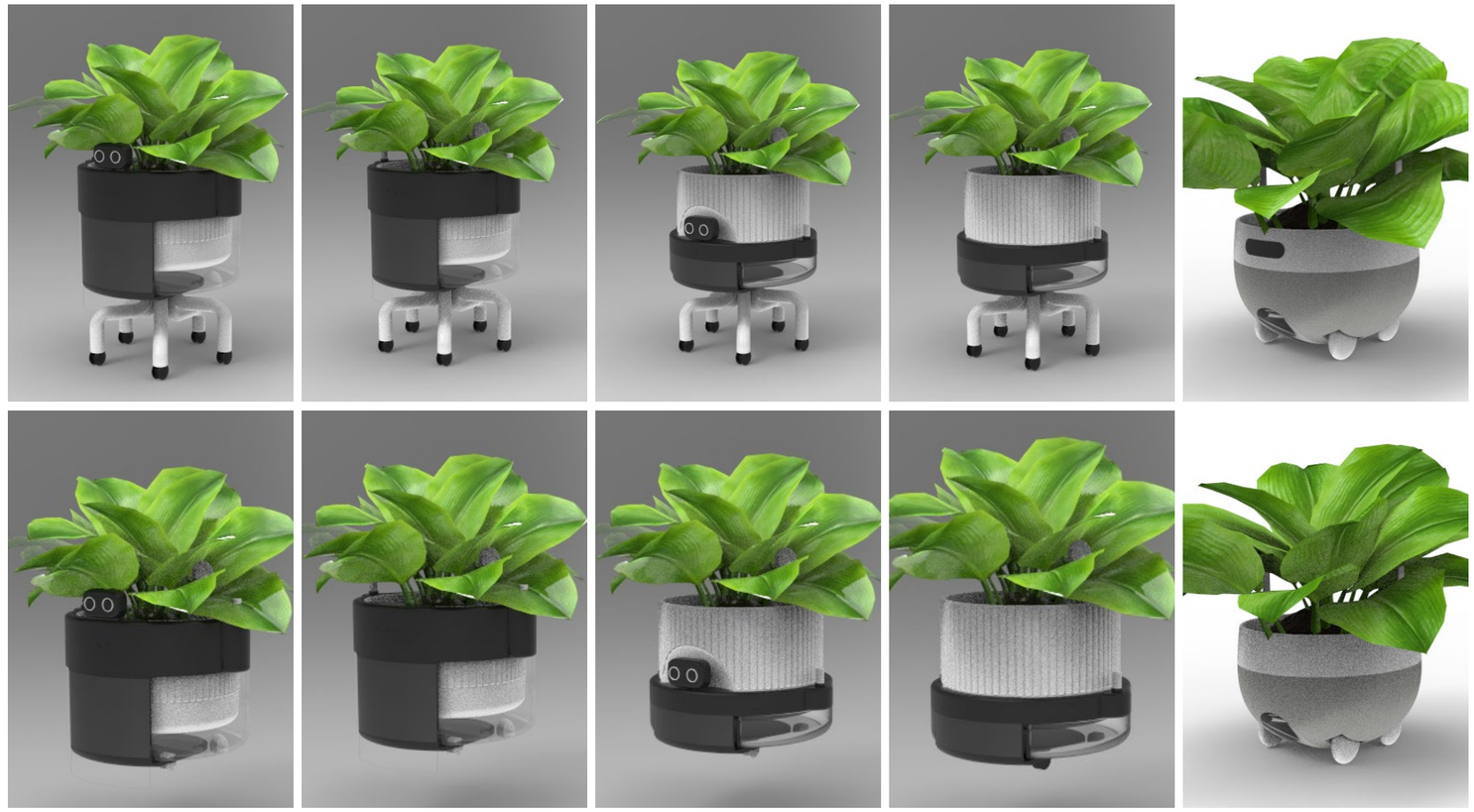
Sensing the presence and direction of light

Can different variables be distinguished by electrical signals

The final storyboard is presented by video and is included in the VIVA Presentation.

Exterior Design Derivation

The focus of the design is to make the product look like a "plant robot" rather than a robot carrying a plant. And to increase the affinity. The option in the box was therefore chosen for the following iterations.



By understanding the existing smart home products on the market, the main focus is on white design. One of them, Google Home, uses fabric and rounded curves to increase the affinity of the product.
The exterior design of PLANTA takes its cue from the design details of Google Home.

Final Design

PLANTA detects and analyses the electrical signals of plants that share the user's thermal comfort, thus understanding the feelings and state of plants that are close to the user in relation to environment. The results of this analysis are used to control the smart appliances in the home (air conditioning, curtains, etc.) to create a comfortable and nature-like environment in the home.

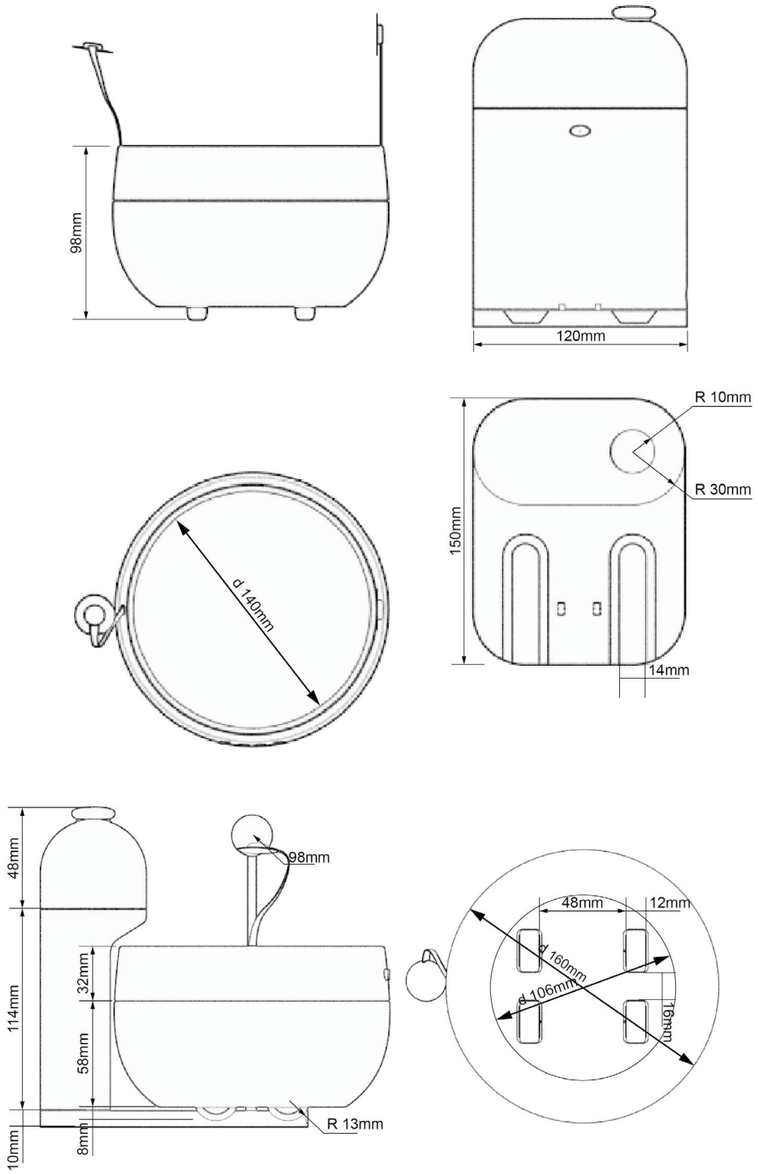
The product is divided into a main part and a base.

The main part is in the shape of a three-tiered planter, which collects the electrical signals from the plant through two electrodes connected to two leaves, and interacts and communicates information to people through LED lights and a wheel.

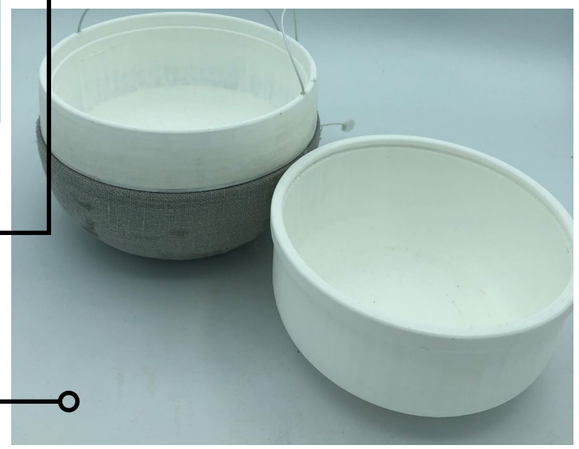
The base part is divided into a charging base and a water container. The product is charged and the plants are watered each night when they return to the base.

Dimensions

The sizes of the products are based on the common sizes of planters and are available in different sizes to suit different plants. Here is an example of one of the sizes.



Prototyping

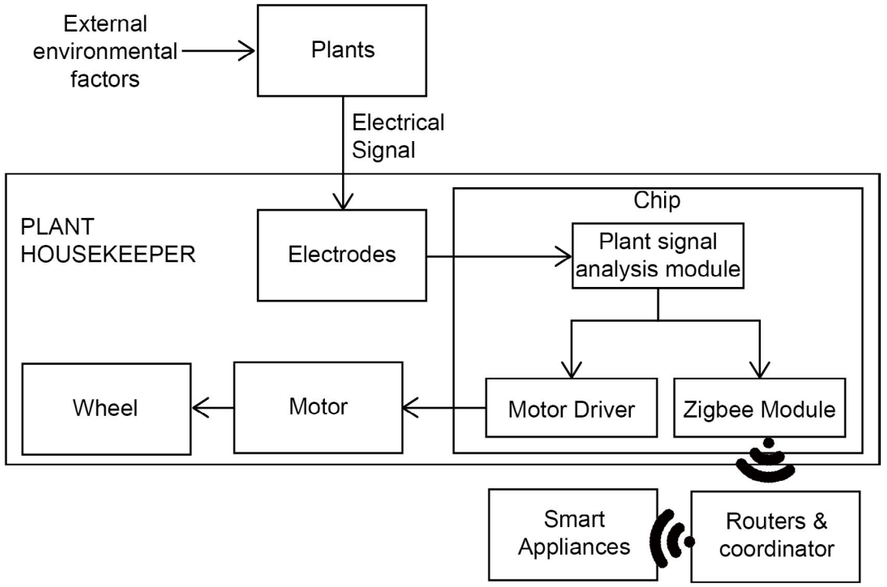


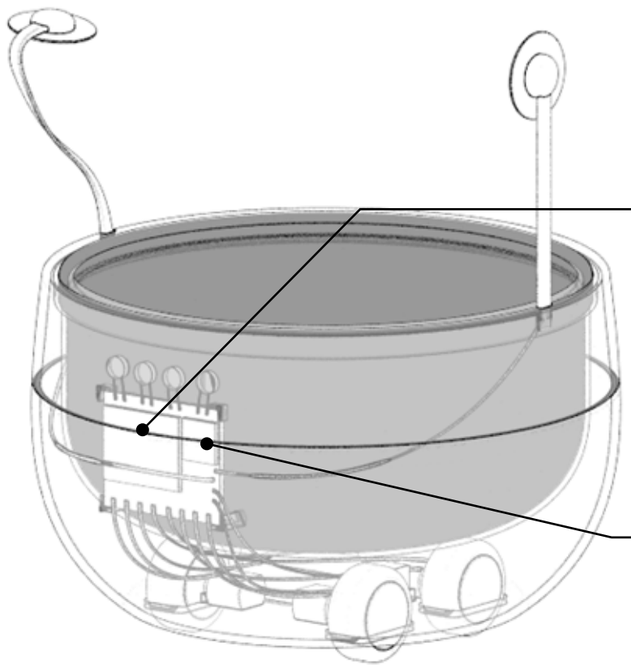
The part of the wheels are exposed at the bottom is too small for movement and needs to be resized.

The tiered design facilitates the installation of plants.

Internal Structure

The working logic of the final product is shown in Figure





Transparent view of the internal structure

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package the finished machine learning training

Exploded view

Future Iterations

PLANTA can also be built into a system with other plants in the home. For example, it can recognise the growth status of other plants in the home and assist the user in caring for them. Or to keep a diary of the growth of other plants.

Personal Reflective Summary

I am very happy and proud to have completed this project that I love. At the same time I have learned a lot of new things as a result, and in particular the technical considerations and implementations have given me a great sense of achievement.

However, there are also areas that still need improvement. The first is the control of exploratory projects. This project was about exploring the use of plants, but the essence of design is still problem solving. In future projects like this one, I should pay attention to the balance between the two.

The second is the timing. I always want to be perfect at every step of the process, but in reality time is limited. This led to a decline in quality as the project had to be rushed later on. It is important to stick to a strict time schedule for each stage.

Reference

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