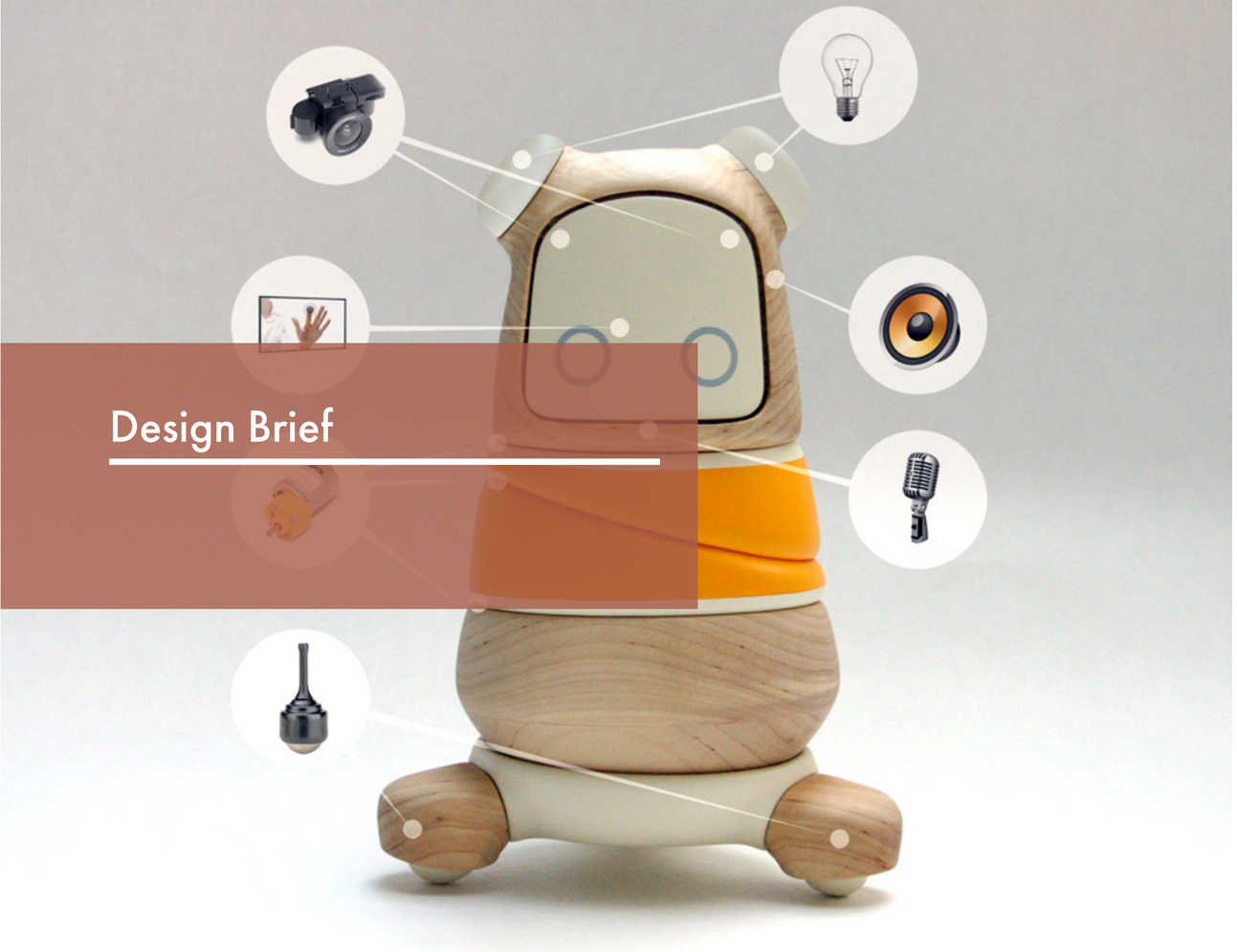
SPROUT

Jacob McMullen

Contents



Design Brief

Description:

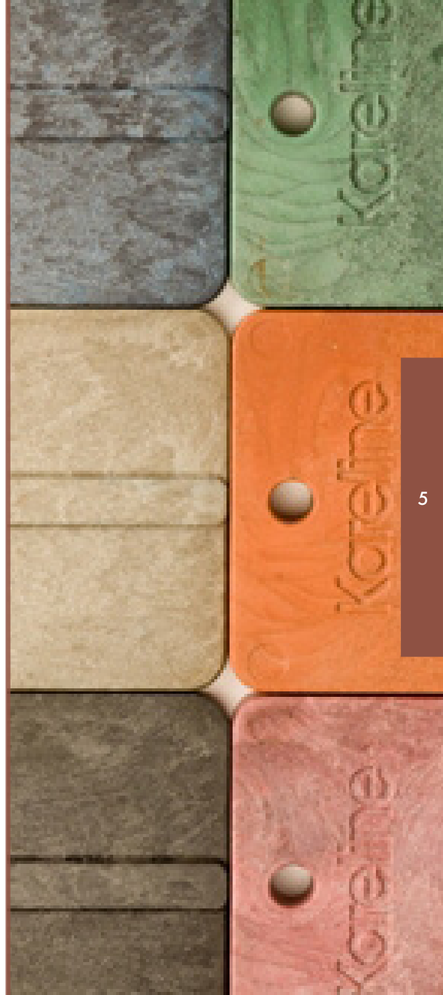
Create a robot companion that is capable of completing basic tasks and helping in every day life.

Brief:

Focusing on an existing robot, redesign it in a way that improves its function or adds features.

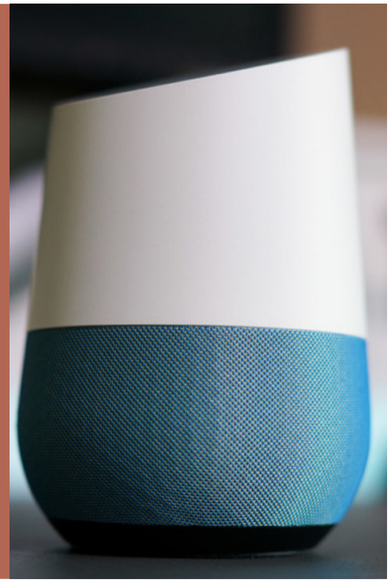
Challenges:

Explore a wide variety of materials and processes to select the most appropriate choice for the robot while avoiding uncanny valley.



Existing Robots

Roomba, Google Assistant



Roomba:

The Roomba is an automatic Vacuum robot with features such as:
Intelligent navigation and Dirt Detect™ technologies. Compatible with Alexa-enabled devices and the Google Assistant to start, stop, or dock your robot. Runs for up to 90 minutes* before automatically docking and recharging.

Google Assistant:

The Google Assistant is a voice activated smart speaker. With just your voice it allows you to find answers, play songs, plan your day, and control your smart home. Works with more than 5,000 smart home devices from more than 150 brands

Design Plan:

My design would fuse the brains of the Google assistant with the mobility of the Roomba. By combining all the features into one robot it would solve many of the issues that each device has separately. The Roomba would have advanced features and the Google Home would have the ability to move from room to room. This would create the ideal companion for any home.

Research

Companion, Persona,Uncanny Valley

55 55 percent of people are more relaxed after spending time with a companion

34 34 percent less likely to develop health issues when working in a room with a plant

40 40 percent of houseplants die during the first year of growth

Companion:

Benefits of Having a Companion:

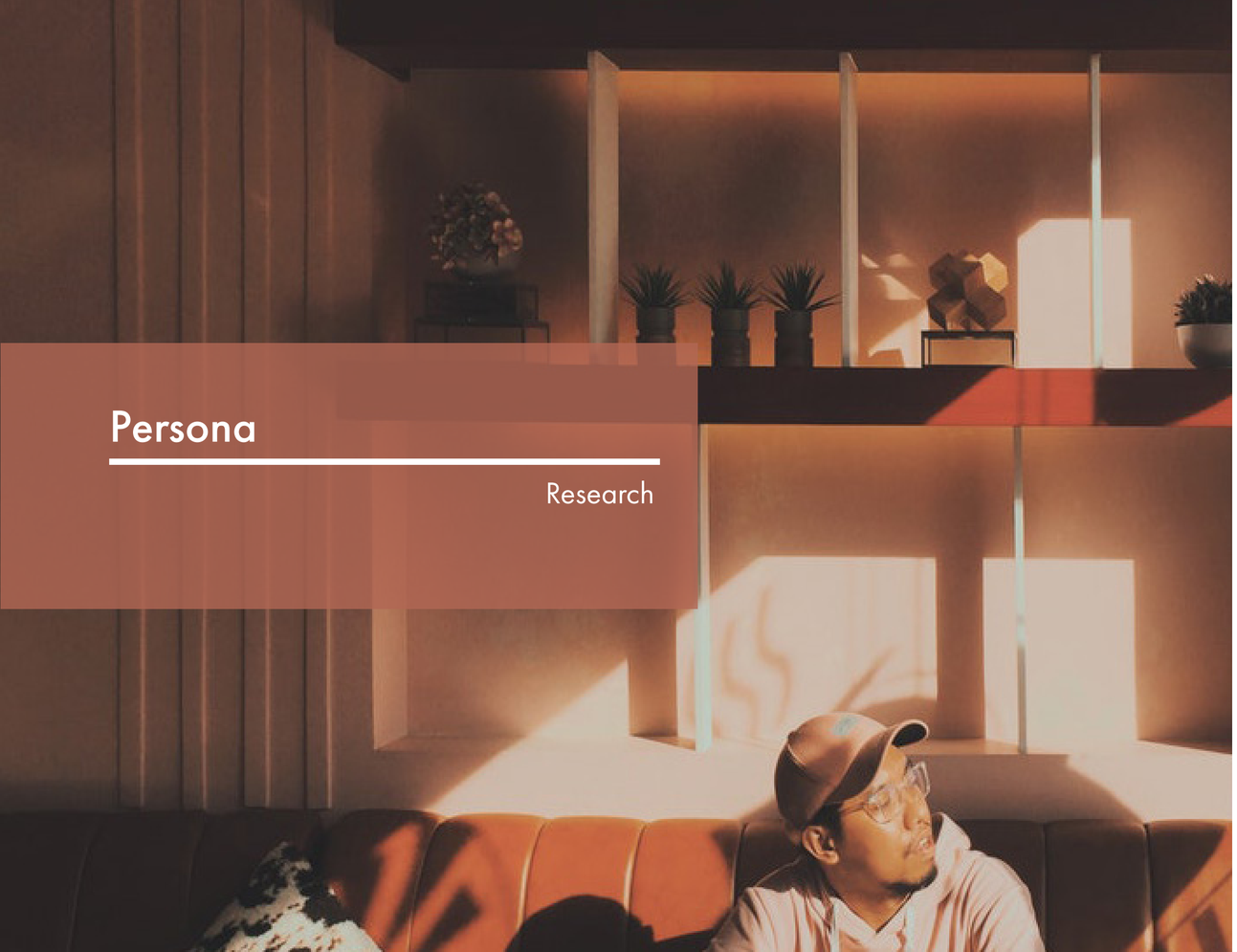
Pets lower stress and anxiety while triggering dopamine in the brain which causes happiness. Animal companions often encourage routine activity that is important for brain function.

Plants and Happiness:

Studies at the Agricultural University of Norway document that using plants in interior spaces decreases the incidence of dry skin, colds, sore throats and dry coughs. Plant play a pivotal role in improving the air quality in a home.

Plant Care:

Plants need a steady supply of sunlight, water and nutrients from soil in order to thrive. The most common reasons plants die is due to insufficient watering, over heating, freezing, and transplant shock.



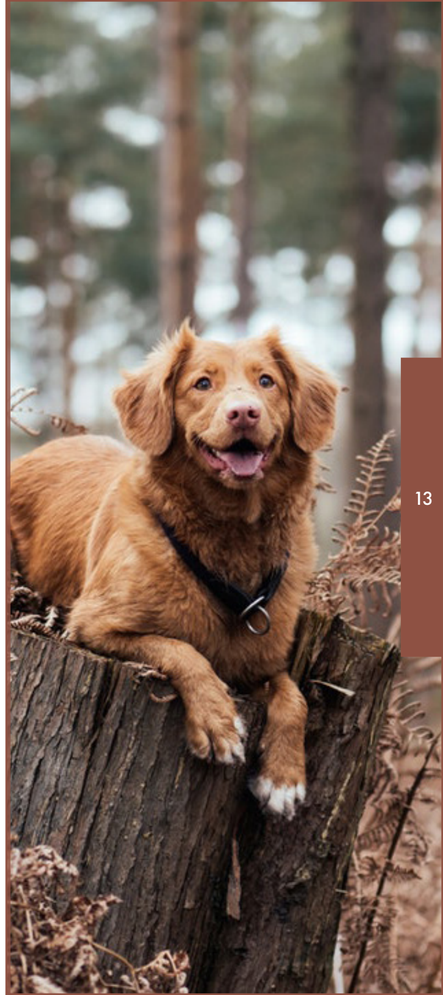
Persona

Research

Mark:

Lives by himself in a building that doesn't allow pets. Due too his isolation from living alone he has become depressed and is in need of a companion.

Although he has always enjoyed plants he has never felt that he has had the skill to keep them alive.

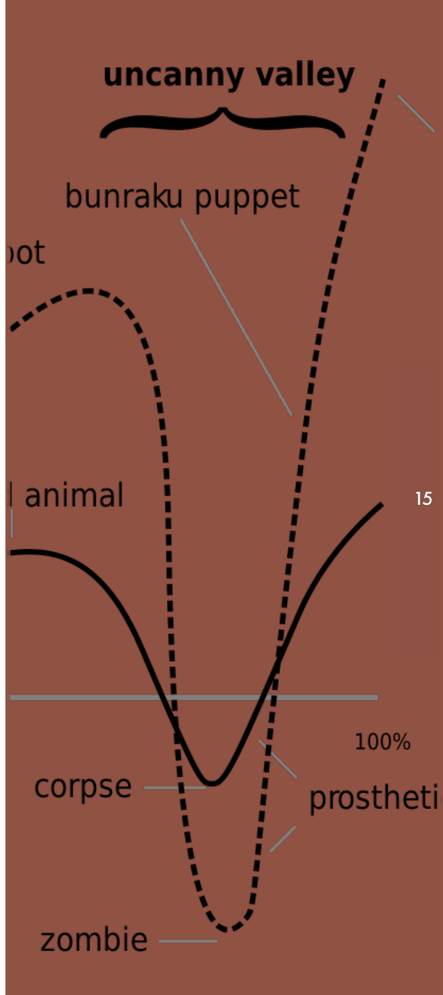


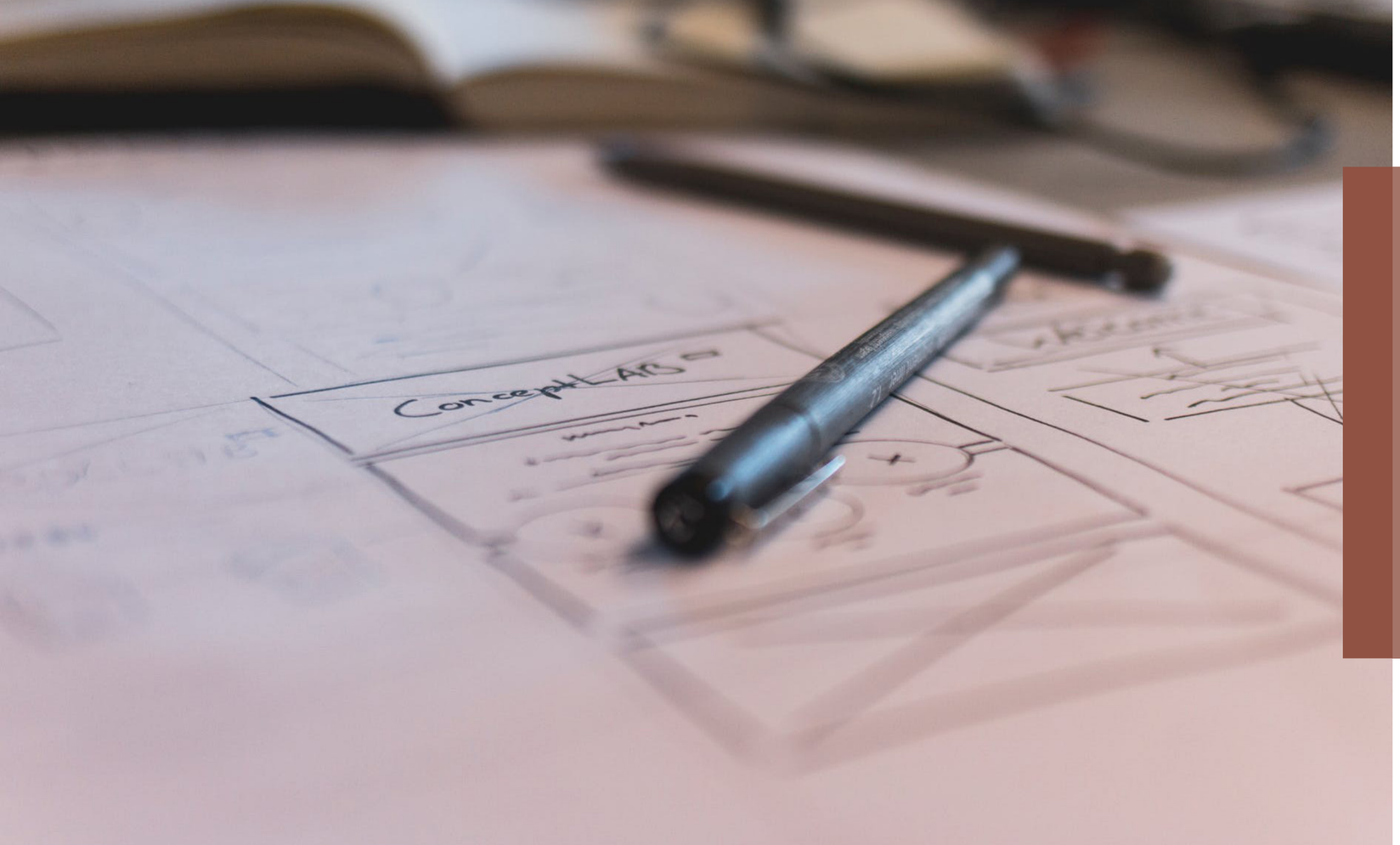
Uncanny Valley

Research

Uncanny Valley

A common pitfall when designing a robot is falling into the uncanny valley. It is defined as the moment when a robot reaches a level of realism in which a human observer has a negative reaction. This is typically when a robot begins to achieve certain human qualities but isn't quite right.



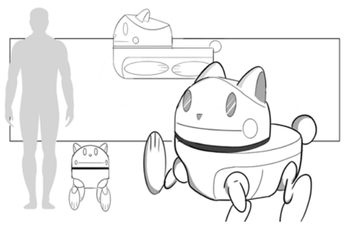


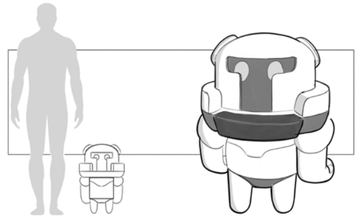
Design Process

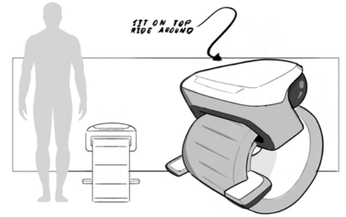
Ideation, Selection

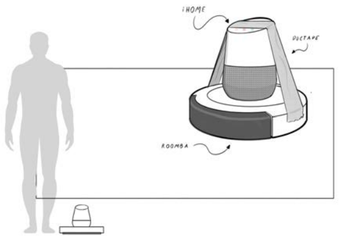
Concept Ideation

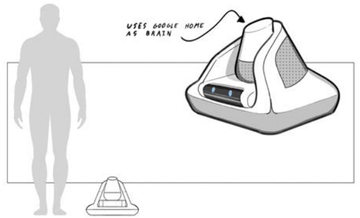
Design Process

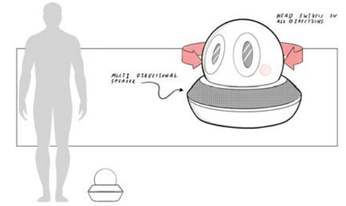


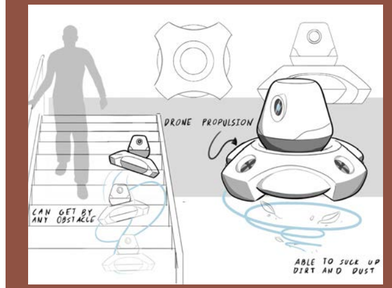


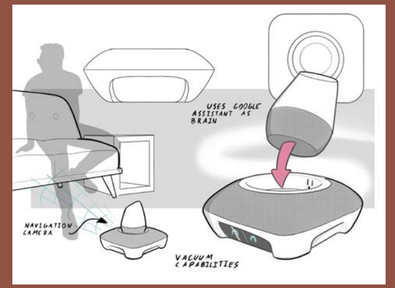


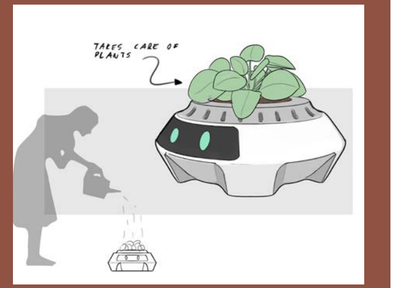












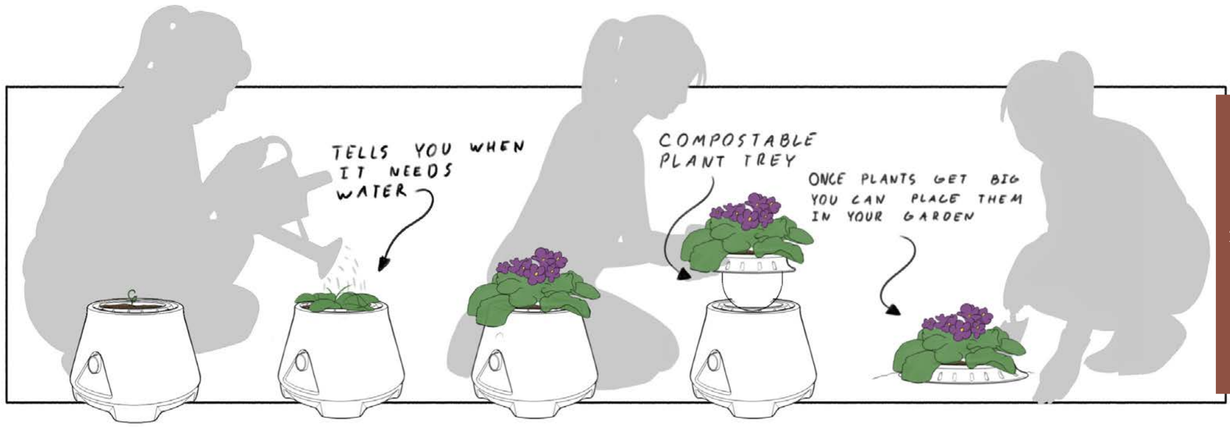
Concept Selection

Design Process

Features

Digital mapping
Smart assistance
Bluetooth communication
Plant care
Facial recognition
Voice activation
Sun tracking
Motorized wheels
Camera navigation
Biodegradable parts
Replaceable plant trey

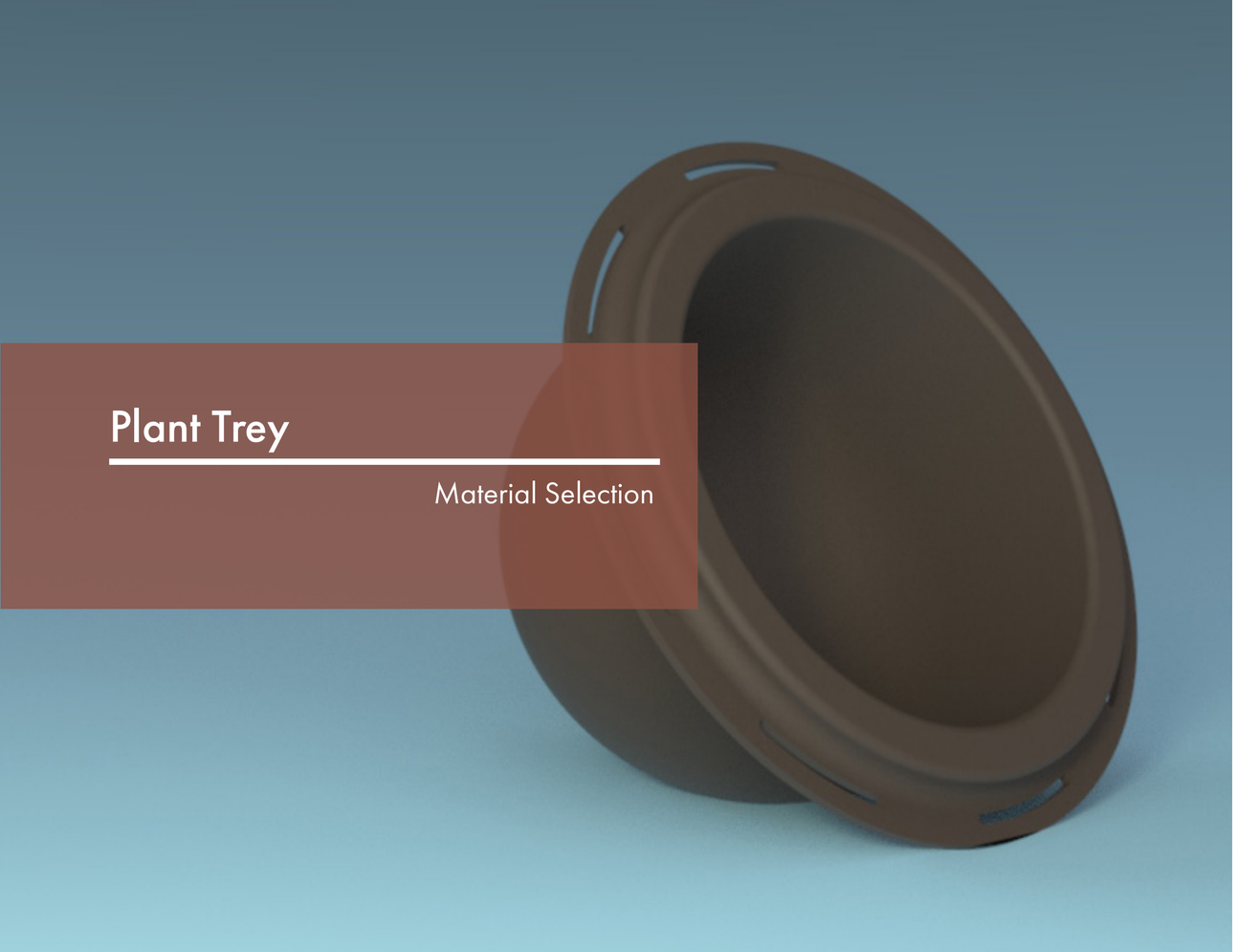
How it works:



Although having all the features of a digital assistant, SPROUT's primary function is plant care. Because of this, it is fitted with a number of technologies that allow it to provide a successful habitat for countless plant species. One of these technologies is a condensation censor that allows it to know when a plant needs water. It also is fitted with an optical sencor that allows it to track the sunlight in the home in order to provide the necessary sunlight a plant needs. Its final feature is a compostable plant trey that allows you to transplant it to the garden with absolutely no risk to the plant.

Material Selection

Trey, Top Shell, Bottom Housing, Wheels



Plant Trey

Material Selection

Paper Foam

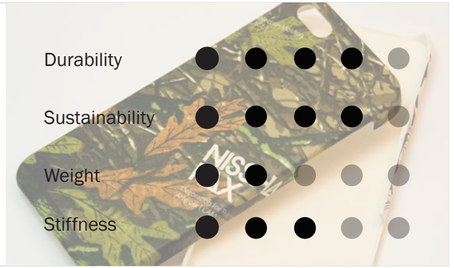
Injection molded foamed pulp that may be used as packaging and as a filler

Mastalmond

Biodegradable masterbatch made from almond shells as a replacement for the mineral and synthetic fibers commonly used in the plastic injection molding industry.

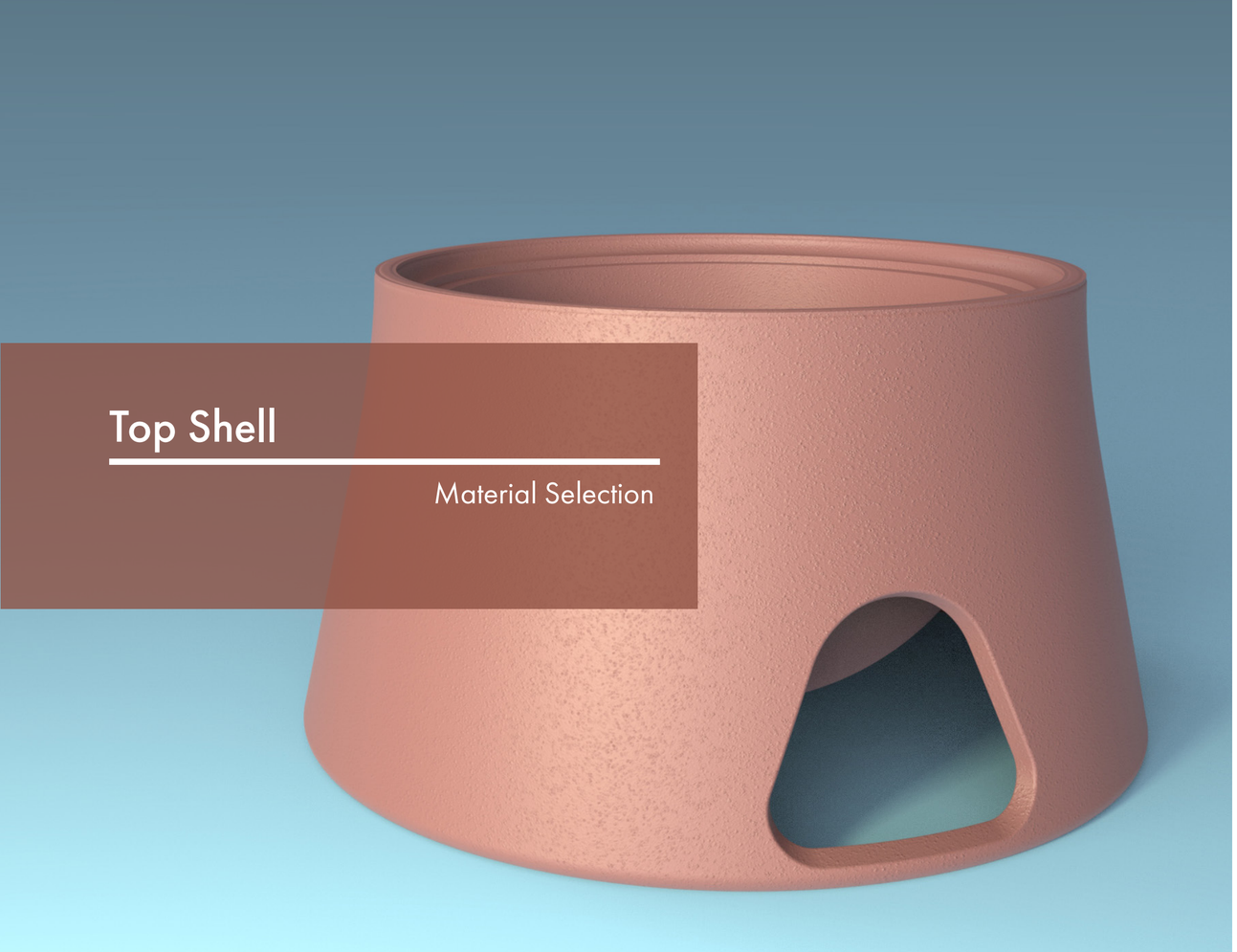
Nisha Pax

Pulp injection molded parts which are made from a pellet composed of 30% paper pulp, 30% starch, 30% water, the remaining ingredients a mixture of (PVA) and antimold



Why

Due to Mastalmonds compostability it is ideal for the plant trey. This will allow the user to transplant the entire trey along with the plant to reduce the chance of damaging the plant during the transplant process. It also offers greater water resistance so it will not loose its integrity after you water the plant.

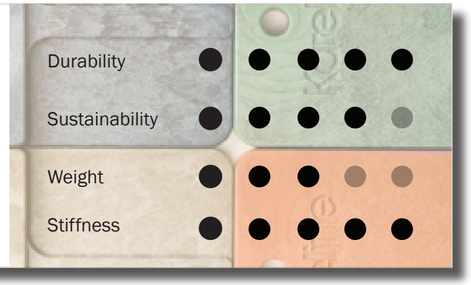


Top Shell

Material Selection

PSMS+Color

Injection moldable polymer made from natural fiber reinforced polystyrene (PS). It has excellent dimensional stability, acoustic absorption and durability.

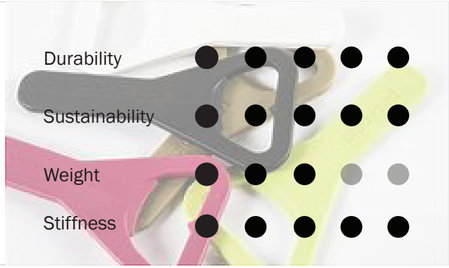


Ncell

The material has excellent impact strength and flexural properties, and can be engineered to meet specific physical properties by changing polymers

Arc Bio

A high-performance, bio-based reinforced plastic with degradable glass fibers for technically-demanding durable applications.

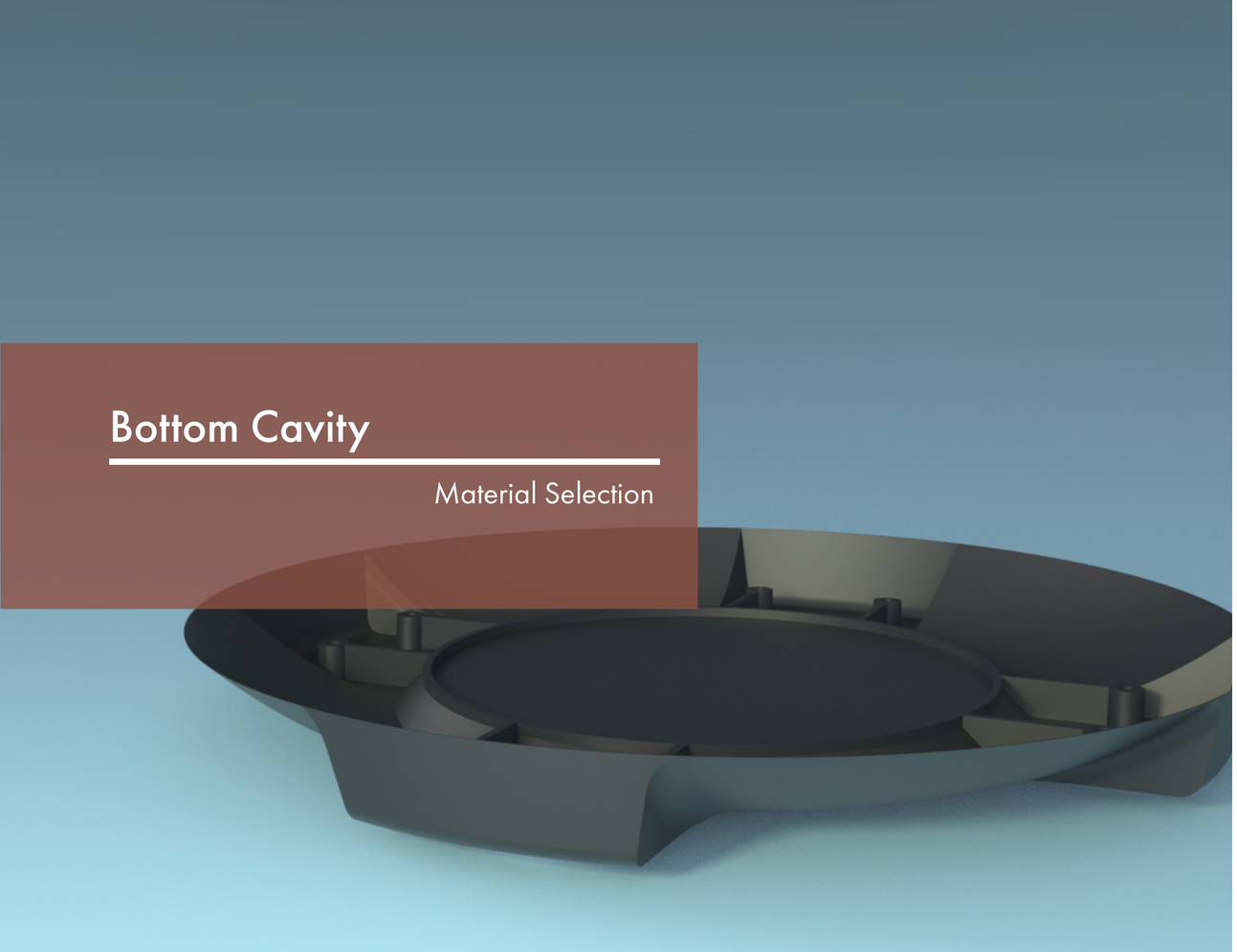


Why

PSMS+Color has a natural pattern that I felt encompassed the plant based design of my robot. It also offered the durability and stiffness needed while remaining light weight. All this combined with the fact that it is biodegradable made it an ideal choice for my robot.

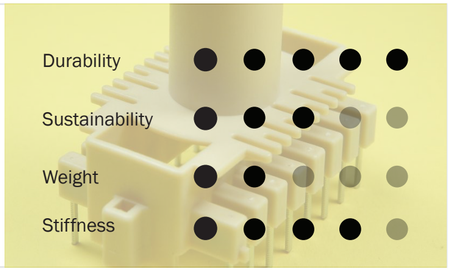
Bottom Cavity

Material Selection



Rynite

Thermoplastics that have a good balance of strength, stiffness, and toughness, good electrical properties, chemical resistance, and surface appearance.



Java Core

Composite material that is composed of 35% to 60% recycled coffee grounds and a polymer binder.

Arc Bio

A high-performance, bio-based reinforced plastic with degradable glass fibers for technically-demanding durable applications.

Why

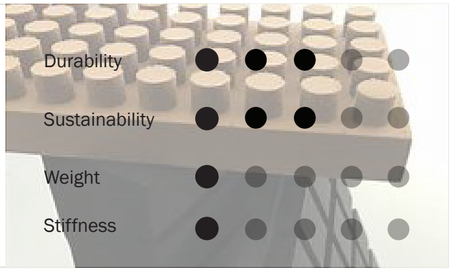
The bottom housing of my robot needed to be durable in order to stand up to whatever may get in the robots way as it moved throughout the home. Arc Bio offered the most durable performance of the materials that I looked at while still being compostable.

Wheels

Material Selection

Polycell

Cross-linked closed-cell foam that may be injection molded direct from compound into a final product

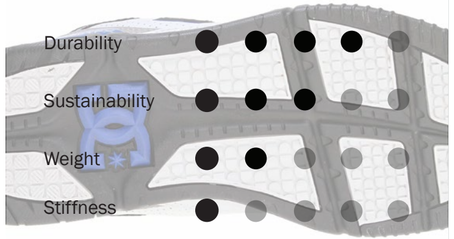


Terratek Flex

Starch-based compostable elastomeric bio-plastic.

Versiflex

This range of durable elastomers are compounded using up to 70% annually renewable resources

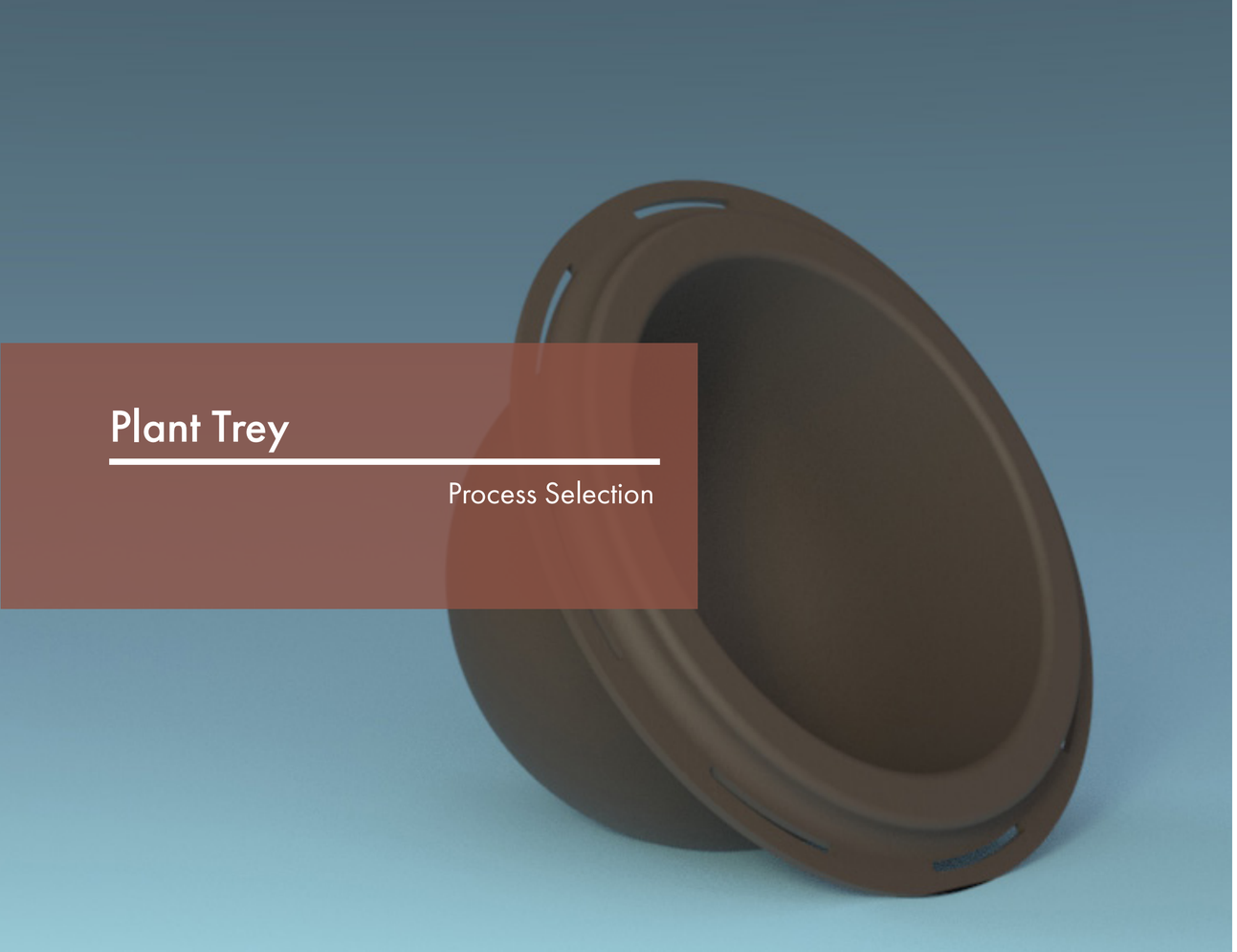


Why

The elastic characteristic of terratek Flex would allow the robot to grip a number of surfaces. It also offered the highest level of sustainability over all the other rubber that I looked at, making it the ideal choice for my robot.

Process Selection

Trey, Top Shell, Bottom Housing, Wheels

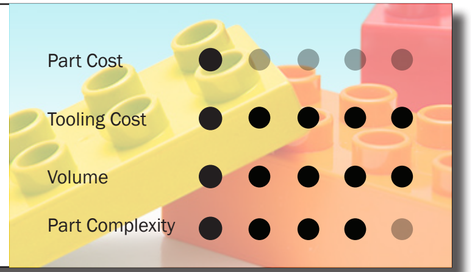


Plant Trey

Process Selection

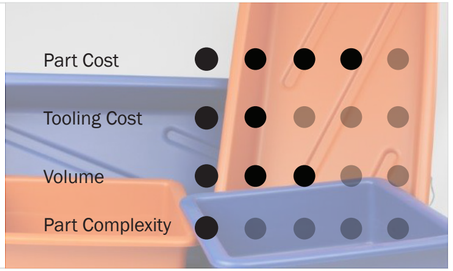
Injection Molded

Plastic pellets are heated and shot into a mold that is then pushed out by ejector pins once the plastic sets



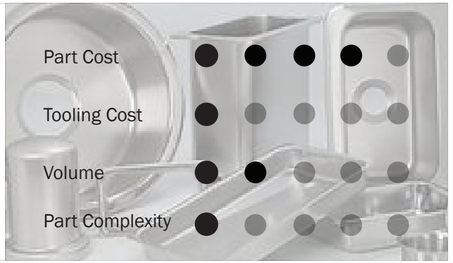
Thermoformed

Plastic is heated and then pressed down onto a male or female mold where it then cools and takes the shape of the mold



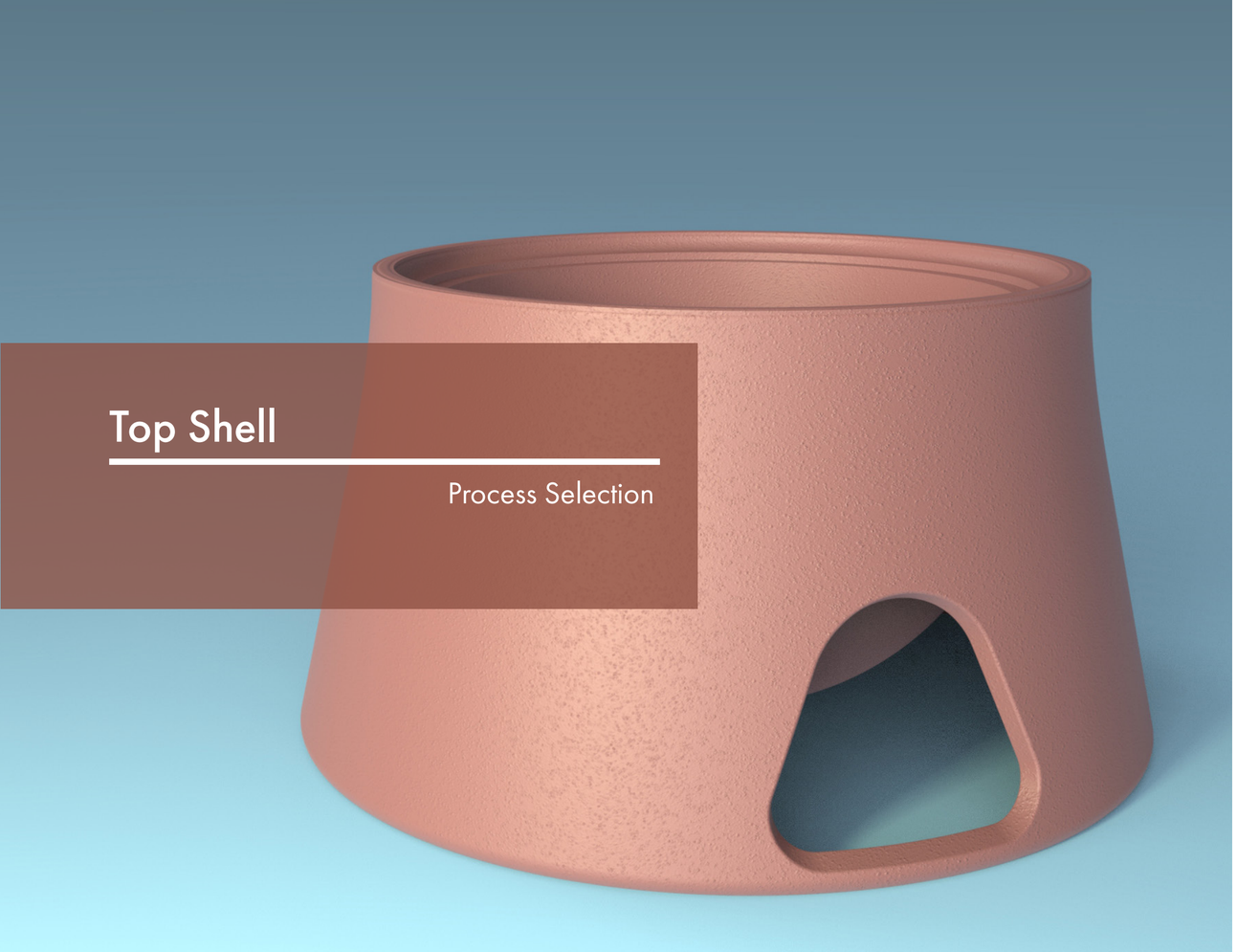
Deep Draw

Using stamps punches and Press's in order to deform a thin sheet of metal to make different forms



Why

My robot will use multiple plant treys throughout its life. Because of this the plant trey will be the most produced part of this robot and therefore requires a process that will allow these high quantities. Injection molding was the clear choice as it allowed for the most parts made in the shortest amount of time.

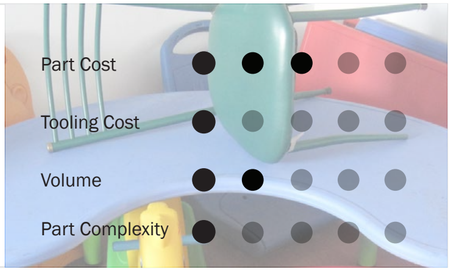


Top Shell

Process Selection

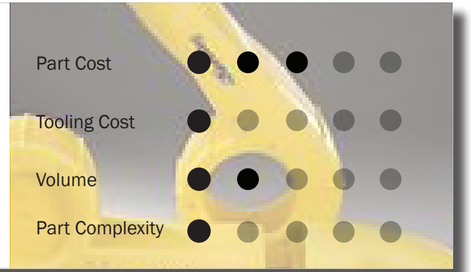
Blow Mold

Melting down the plastic into a parison where air is then injected into it giving the plastic its shape.



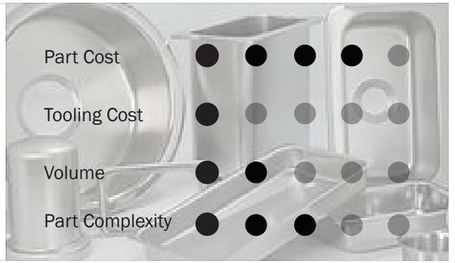
Roto Mold

Powder is heated and rotated in an multi axis mold. Once it hardens it is removed from the mold and preped



RIM

Two equal parts of chemicals mix together and are injected inside a mold where the material expands to the shape of the cavity

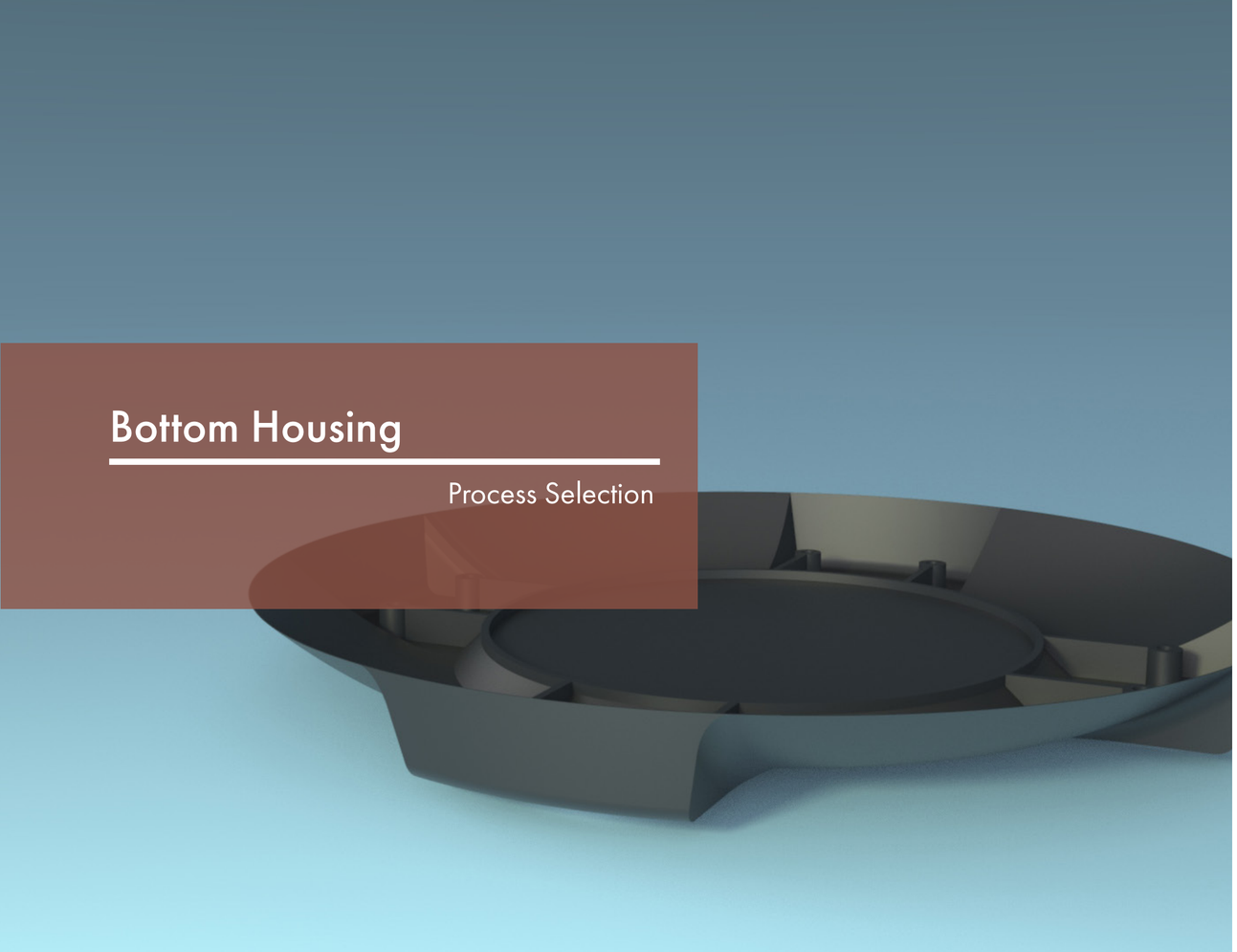


Why

Due to the nature of roto molding it creates very little waste as well as a minimal part line. Is also Is ideal for the material I chose.

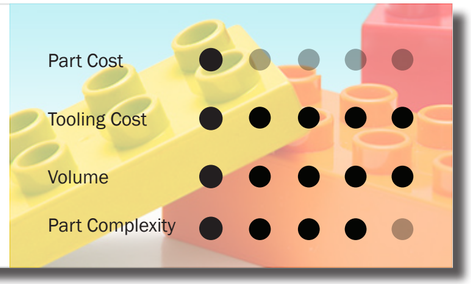
Bottom Housing

Process Selection



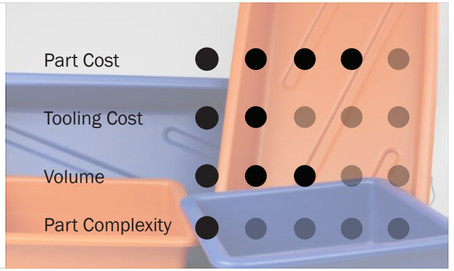
Injection Molded

Plastic pellets are heated and shot into a mold that is then pushed out by ejector pins once the plastic sets



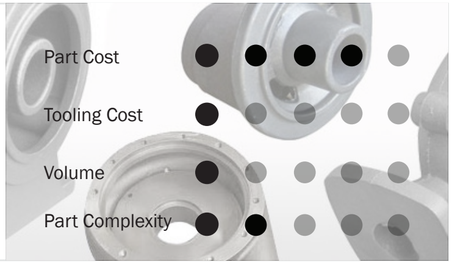
Thermoformed

Plastic is heated and then pressed down onto a male or female mold where it then cools and takes the shape of the mold



Sand Casting

Pack sand around a form to create a mold then pour liquid aluminum into the sand mold. After aluminum returns to its solid state



Why

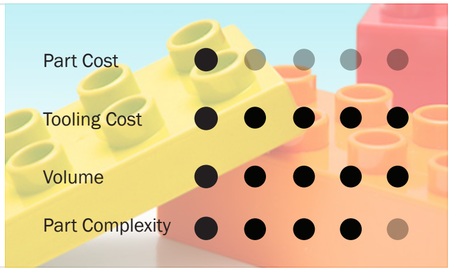
It was important that the bottom housing be injection molded because it allows for a more complex part that can include fasteners. Including fasteners in the mold such as pin guides and clips, allows me assembly my robot quickly therefor cutting down cost.

Wheels

Process Selection

Injection Molded

Plastic pellets are heated and shot into a mold that is then pushed out by ejector pins once the plastic sets

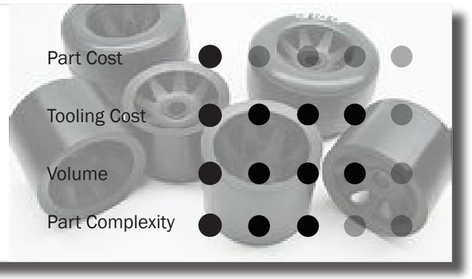


Compression Mold

A surplus of material is placed into the mold where heat and pressure are then added allowing it to fill the cavity.

Rubber Casted

A liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify.

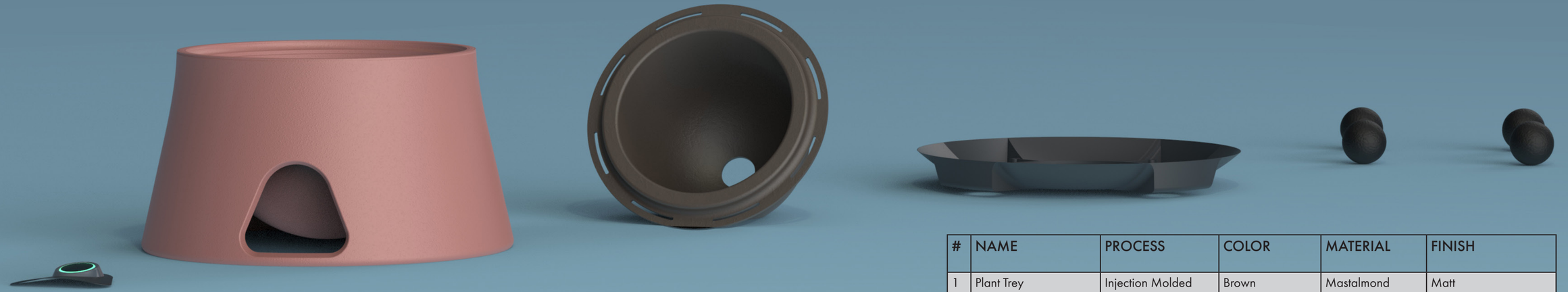


Why

Due to the size and material of my wheels rubber casting made the most since. It allows them to be made cheaply and easily.

Final Design

BOM, In Use



#	NAME	PROCESS	COLOR	MATERIAL	FINISH
1	Plant Trey	Injection Molded	Brown	Mastalmond	Matt
1	Top Housing	Roto Molded	Brick	PSMP+ Color	Rough Texture
1	Bottom Housing	Injection Molded	Ash Grey	Arc Bio	Pitted Texture
4	Wheels	Cast Rubber	Black	Tarreteck Flex	Matte divotted

In Use

Final Design

In the home:

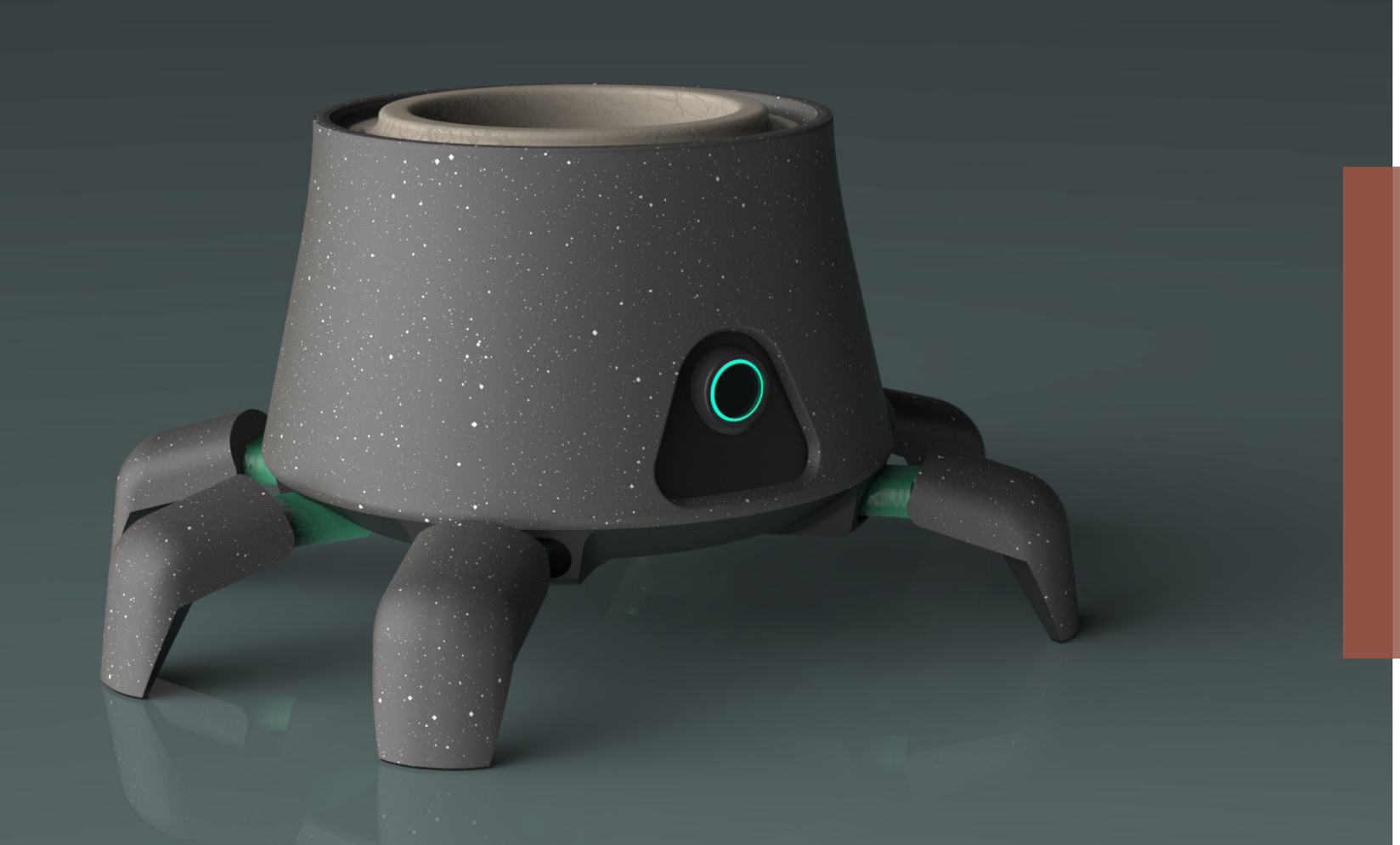
SPROUT is a smart assistant that is not limited to one room. Its motorized wheels and camera navigation allows it to move effortlessly around your home. You can now access its features by calling it to you just like you would call a pet.

Making connections:

Due to the incorporation of a living plant, SPROUT can create a better connection with its owner. It relies on the owner for water in order to keep the plant healthy which creates a harmonious relationship that wouldn't otherwise be possible. By seeing the plant grow it also allows the owner to form a visual connection as if SPROUT is growing as well.

Plant focused:

After telling it what plant it will be taking care of, SPROUT automatically knows the appropriate water and sunlight to give it. When not helping you with your daily life, SPROUT will search your home for the ideal lighting so that the plant to grow successfully.

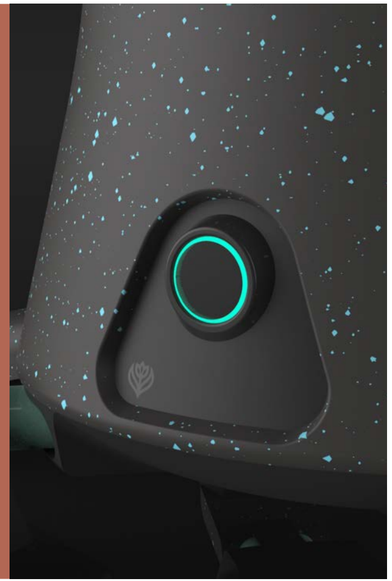


Future Robot

Features,

Features

Future Robot



Wireless Charging:

Wireless charging is when a transmitter transfers a current of electricity through the air to a receiver. Currently most devices can only be charged wirelessly if they are in close proximity of the transmitter, However since my robot is projected to be possible 10 years in the future I can assume that the range will be increased significantly by then.

Motorized legs:

Motorized legs are currently being improved greatly in the field of robotics. This can be seen in robots such as MIT's MINI CHEATAH. In 10 years it is reasonable to assume that this technology will be commercially available.

Artificial Intelligence:

AI is currently one of the greatest advancements in robots. Although it is not yet perfect, It is already at a level ware it can be helpful in day to day life.

THANK YOU