Stride.

Industrial Design Engineering

ottobock.

Concept Selection

Selected Concept

Based on questionnaire results and feedback from stakeholders, the chosen design concept was a boundary detection stick, **Stride**.

The aim of this product is to target the common symptom, freezing of gaits (FoG), which a majority of Parkinson's patients experience. Stride provides haptic feedback to users based on the changing environment such as going from one room to another.

This device's objective is to provide patients with the confidence to remain independent, social and safe, through a robust build and intuitive user interface.

Redesign Rationale

"I think this is a good Stick which will help provide stability when walking and have some added benefits in relation to spatial awareness, but I don't know how directly it will assist with Parkinson's symptoms"

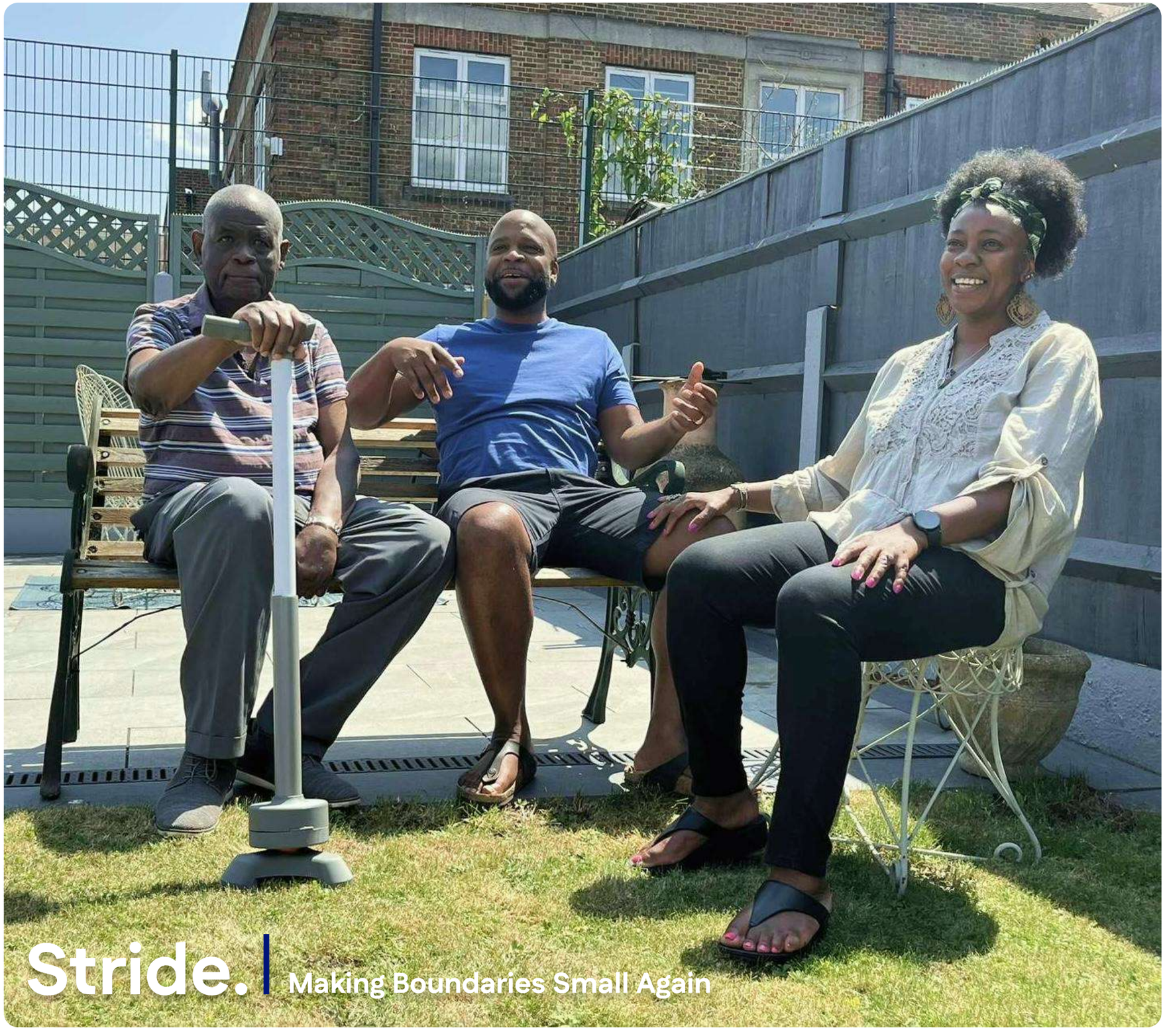
The feedback received for this concept acted as the driving force behind the first wave of design refinement. The ergonomics of the handle was called into question as well as how efficient the vibrational system would be.

Focal Areas

Ergonomics

Efficiency

Functionality



Concept Development

Ergonomic Development

The user experience was an important element for this product, so the form of the handle and base were developed, to ensure user **comfort**.

Handle Iterations | Report 4.1.1

For the redesign of the handle, the aim was to provide more support for the user, when pressure was applied, as well as increase overall ergonomics.

1

Handle design was changed to a shape which offered more support to users.

2

Buttons were moved up the handle, for more natural positioning.

3

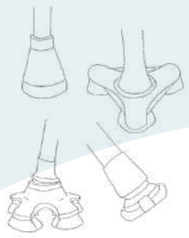
Bumps were added to the handle's underside, for increased ergonomics.

4

The dimple at the side of the handle was removed, to increase aesthetic appeal.

Revised CAD Handle

Base Development | Report 4.1.3

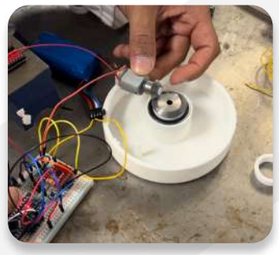


After testing multiple base sizes, the median size was chosen due to its **functional harmony** (aesthetics and balance).

Concept Development

Mechanism Testing | Report 4.2.1

How might we ensure the extension and compression function works reliably and smoothly?



Extension mechanism tested with basic DC motor.

Lead screw oiled and gears greased to reduce friction.

Power supply used to test the required current and torque calculated.

Tested with a more power dense, gear motor.

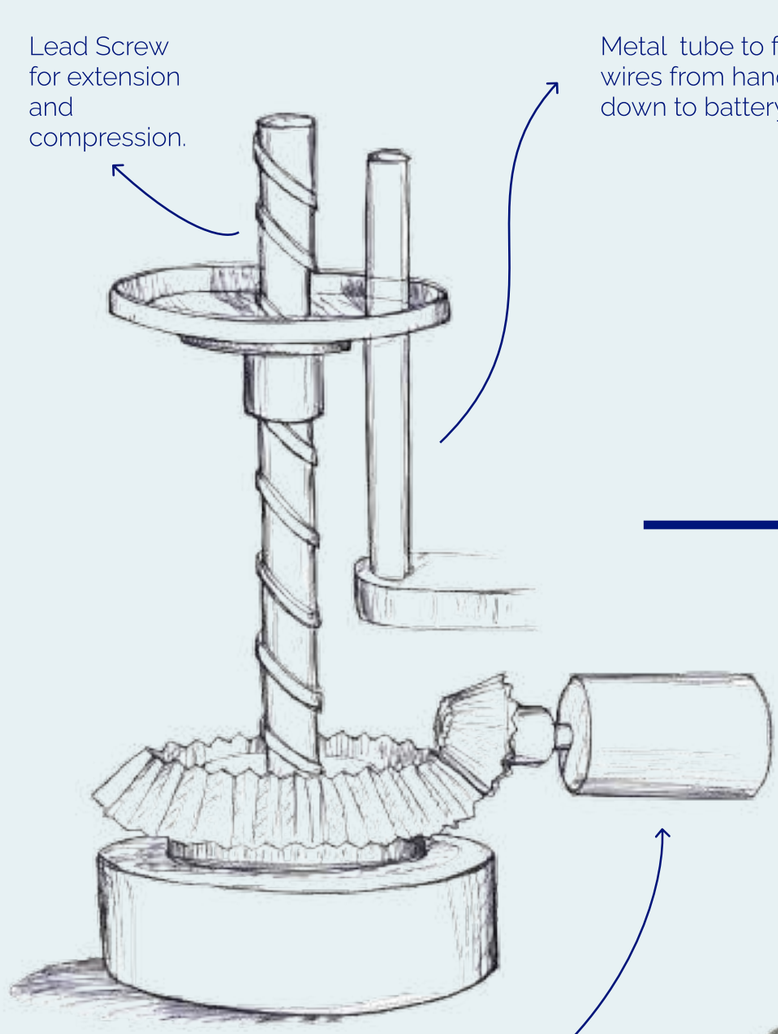
Extension works efficiency and reliably.

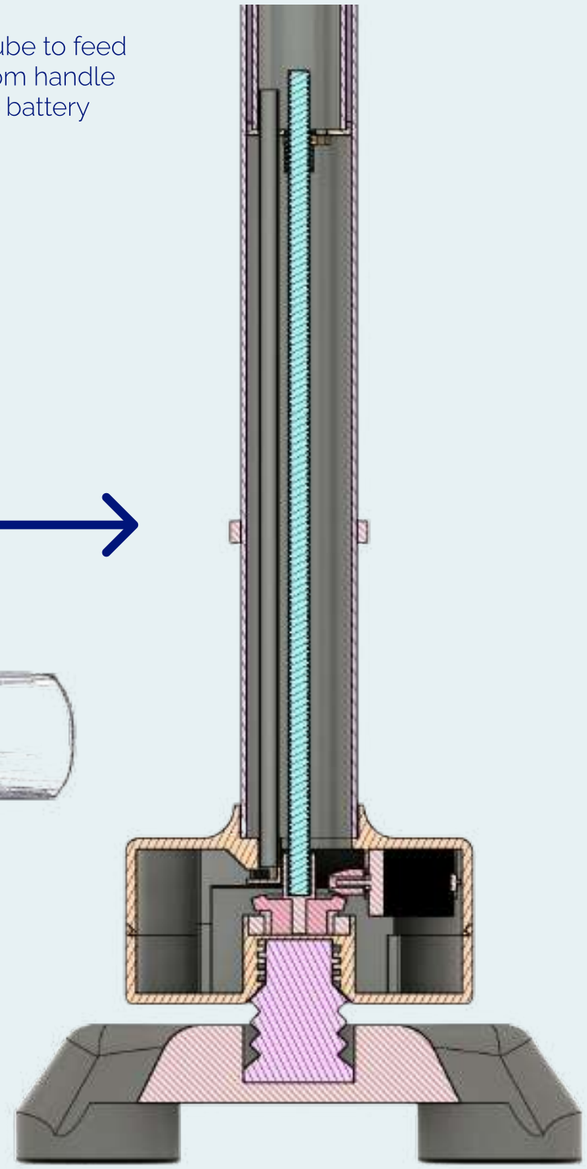
Mechanism Development

In addition to the haptic feedback system, Stride has two buttons controlled extension and compression mechanism - to aid users sitting and standing. Problems were encountered, when it came to how well the mechanism would fair under the load of a user standing up. Thus, further ideation and sketching was done.

Lead Screw for extension and compression.

Metal tube to feed wires from handle down to battery





By introducing a bevel gear, it was possible to move the motor outside the direct line of pressure, solving the problem of the motor being under immense load.

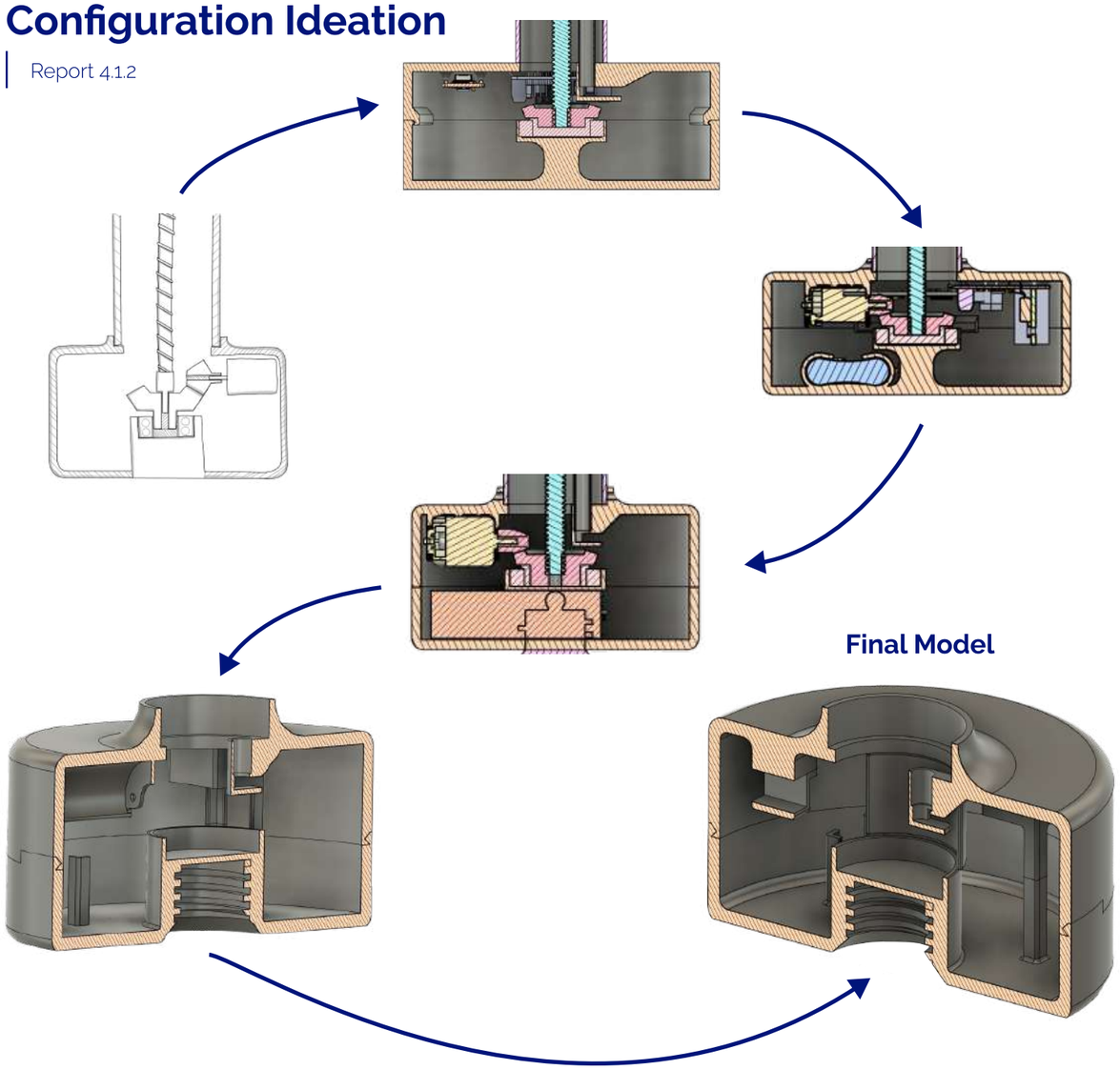
Concept Development

Casing Development

Through developing the mechanism, some aesthetic issues were encountered, therefore, with consequent iterations **“How might we reduce the perceived bulk of the electronics casing, to minimise affect on the products aesthetics?”** was the driving question.

Configuration Ideation

Report 4.1.2



Final Model

Clearance between the top and bottom casing had to be increased to ensure the motor was free to spin and thus move the bevel gear, as this was an issue found through testing.

Casing Iteration #1

Casing Iteration #2

Casing Iteration #3

Casing Iterations

Ultimately, it was decided that the shorter, but wider cylindrical design found the best balance between component spacing and aesthetic appeal - it allowed the sleek, modern look of Ottobock products to be maintained, whilst comfortably housing all the necessary components.

Brand Analysis

Est. 2014 [26]
Revenue N/A

CAN Go

Core Principals

Smart Cane. Smart Steps. [26]

CAN is a tech company which specialises in producing connected mobility aids for the elderly, and those with reduced autonomy. They pride themself on creating solutions, which facilitate independence.

- Safety
- Responsiveness
- Creativity
- Autonomy

Mission:
This companies mission is to help people stay mobile and safe, as well as make care giving a more efficient process. [26]

Ottobock

Est. 1919 [5]
EUR 1.6 Billion [28]

Core Principals

Be Human, Be Reliable, Be Inventive and Be Smart. [5]

Ottobock is modern prosthetics company which specialises in creating personalised equipment, through the integration of technology, to aid people in retaining their mobility and freedom.

- Personalised
- Innovation
- Holistic Solutions
- Meaningful Design

Mission:
Ottobock believes greatly in improving the quality of life of their users through technological innovation.

Est. 2017 [31]
EUR 5 Million [32]

byAcre

Core Principals

Built to last. Easier to repair. Kinder to the Planet.

byAcre is a mobility design company, who blends functionality, minimalism and ergonomics in their products. These principles are showcased in the world's lightest rollator, which they designed.

- Simplicity
- Durability
- Design
- Sustainability

Mission:
byAcre's lifework is to create mindful mobility aids, which don't feed into outdated rhetoric about those with limited/ reduced mobility. [31]

Brand Implementation

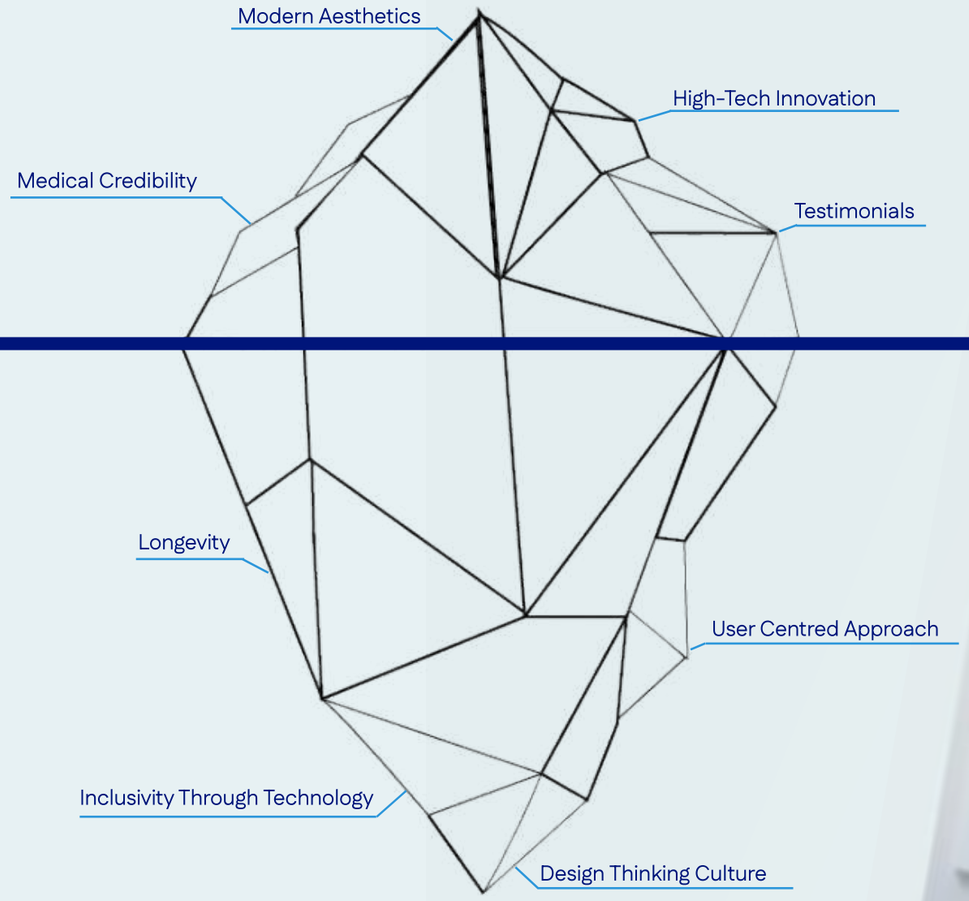
Report 8

ottobock.

C-Leg 4:

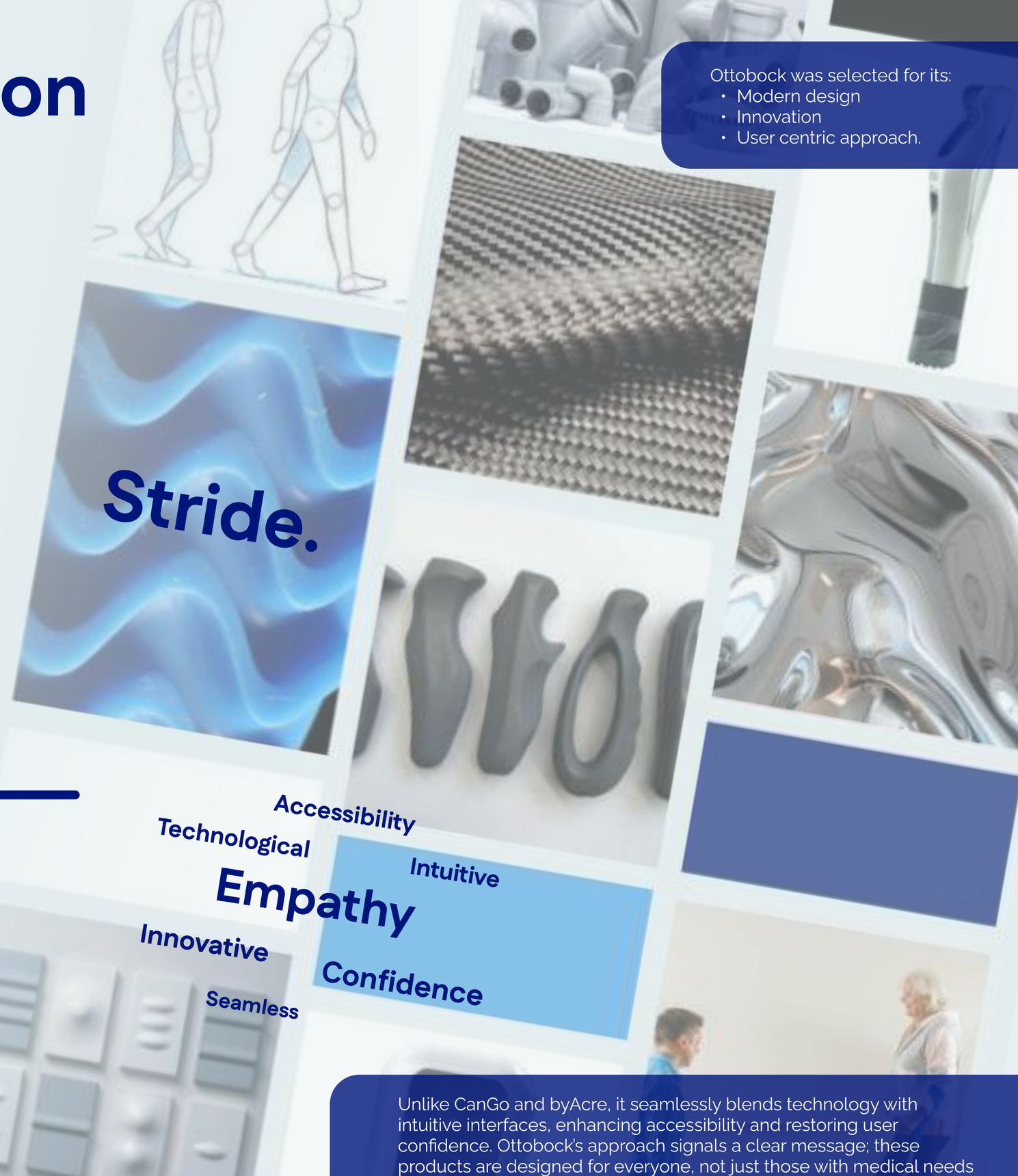
The C-Leg 4 greatly represents Ottobock's values and organisational strategy. This prosthetic includes patented technology, which facilitates personalised experience by each user. This is shown through the many success stories [30]. In addition to technological innovation, the C-Leg is offered through the NHS to those who would benefit from such a prosthetic, further reflecting Ottobock's driving desire - to improve people's quality of life.

Brand Iceberg



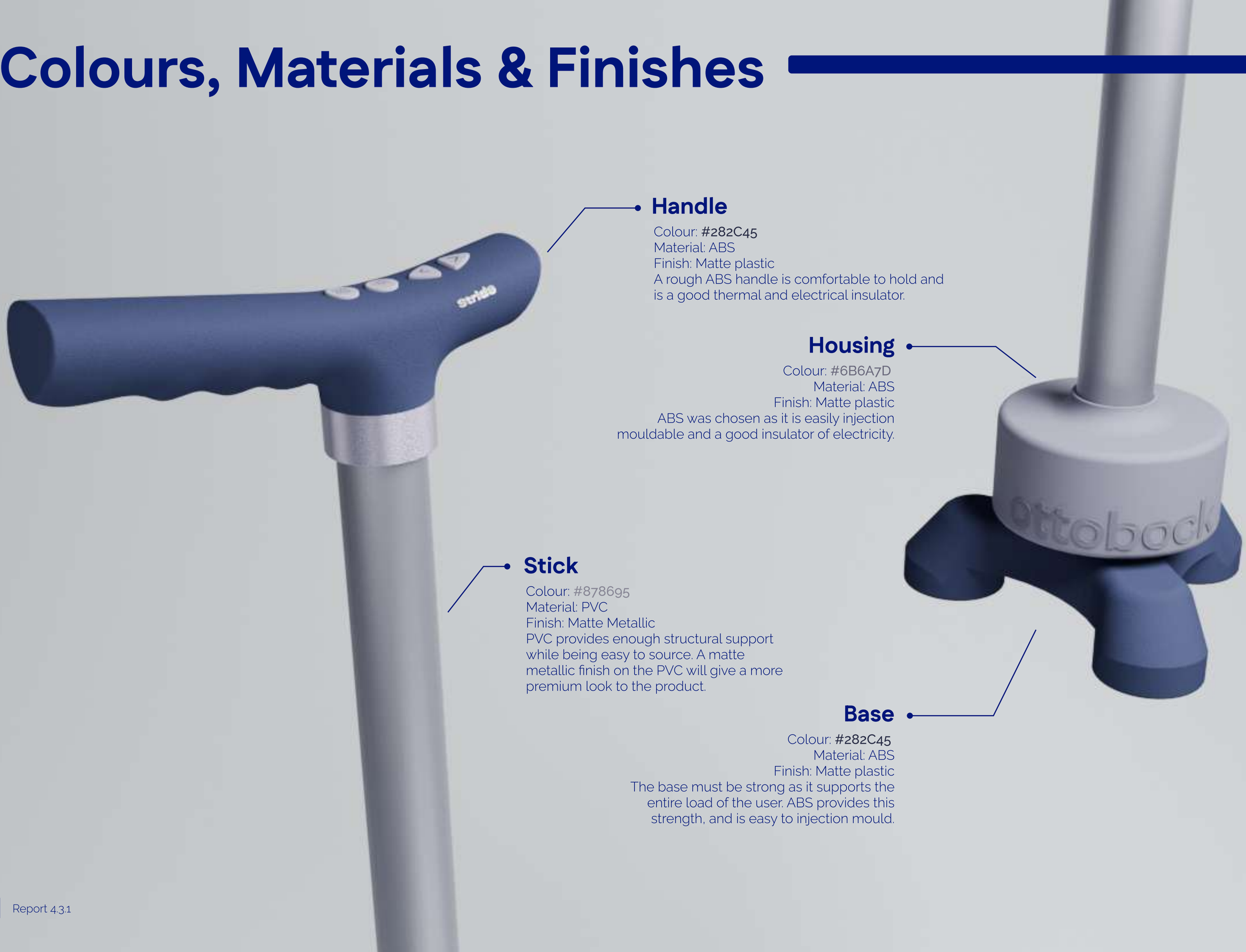
Ottobock was selected for its:

- Modern design
- Innovation
- User centric approach.



Unlike CanGo and byAcre, it seamlessly blends technology with intuitive interfaces, enhancing accessibility and restoring user confidence. Ottobock's approach signals a clear message; these products are designed for everyone, not just those with medical needs

Colours, Materials & Finishes



Handle

Colour: #282C45
Material: ABS
Finish: Matte plastic
A rough ABS handle is comfortable to hold and is a good thermal and electrical insulator.

Housing

Colour: #6B6A7D
Material: ABS
Finish: Matte plastic
ABS was chosen as it is easily injection mouldable and a good insulator of electricity.

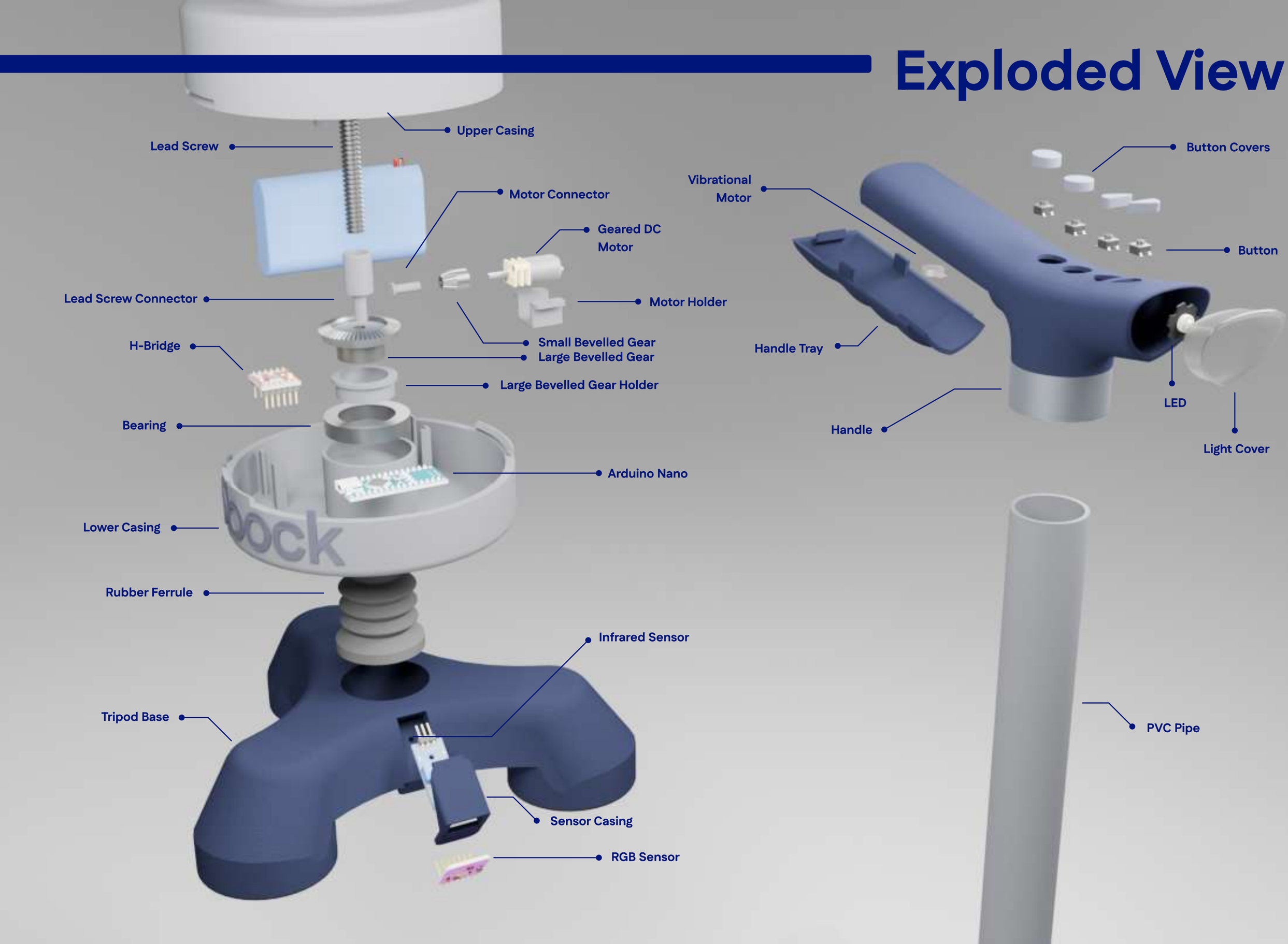
Stick

Colour: #878695
Material: PVC
Finish: Matte Metallic
PVC provides enough structural support while being easy to source. A matte metallic finish on the PVC will give a more premium look to the product.

Base

Colour: #282C45
Material: ABS
Finish: Matte plastic
The base must be strong as it supports the entire load of the user. ABS provides this strength, and is easy to injection mould.

Exploded View



Detailed Design

Design for Manufacturing & Assembly

The design of Stride was optimised to make manufacturing and assembly as efficient as possible. To do this several DFMA considerations we applied during the design process, adhering to ISO 8887 [29].

Design Considerations

Standard Components

Standard M2 and M3 nuts have been used, as well as M3 nuts and electronic components.

Non-Permanent Joints

Joints do not require permanent glue etc, hence assembly time is reduced.

Suitable Tolerances

Parts have been designed with suitable tolerances to ensure good fits.

Self Aligning Features

Snap fits on the housing act as a self aligning feature, facilitating easy assembly.

Uniform Thickness

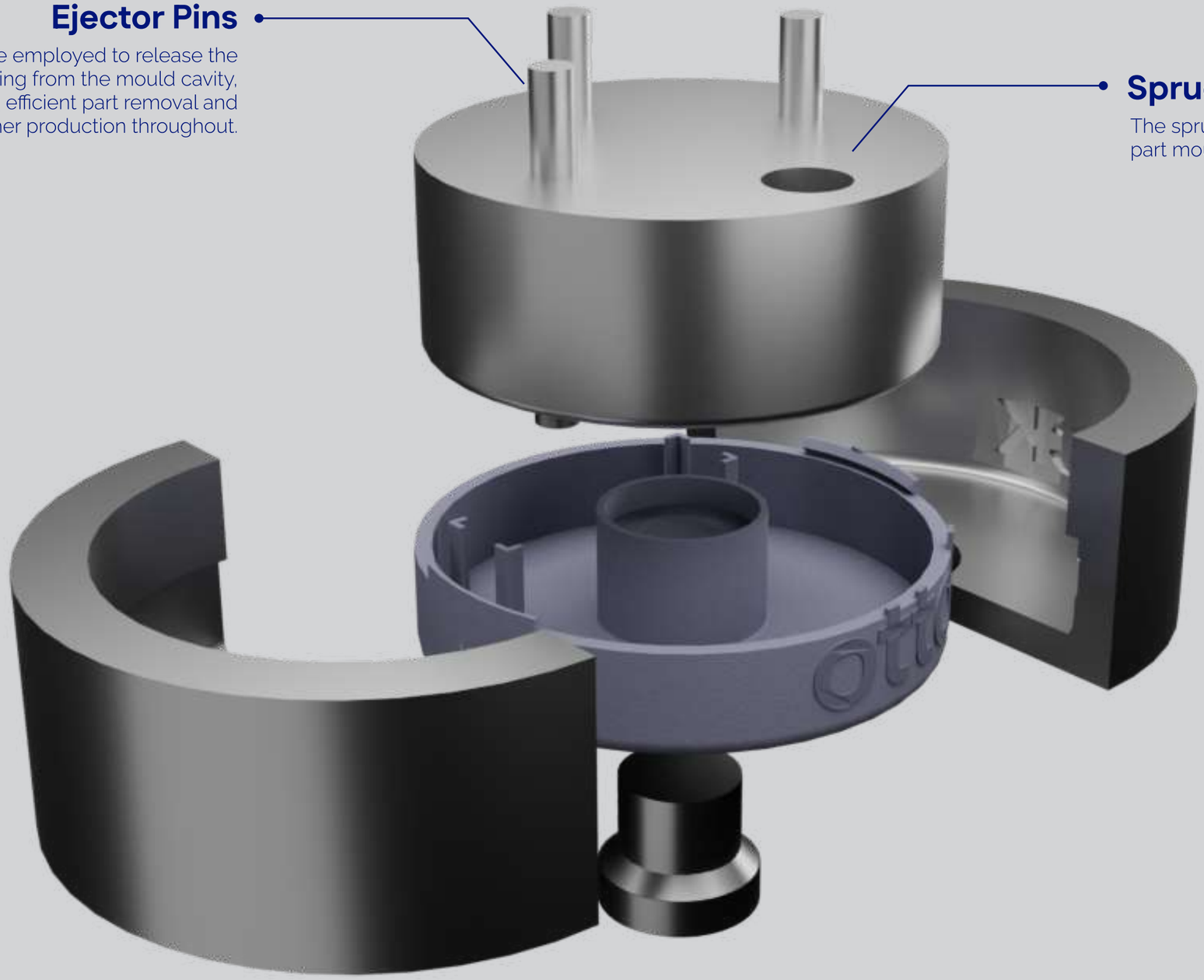
Uniform thickness of housing and handle make them suitable for the injection moulding process.

Detailed Design

Injection Mould for Housing

Ejector Pins

Ejector pins are employed to release the bottom housing from the mould cavity, enabling efficient part removal and supporting higher production throughout.



Sprue

The sprue delivers molten plastic into the four-part mould, initiating the filling process.

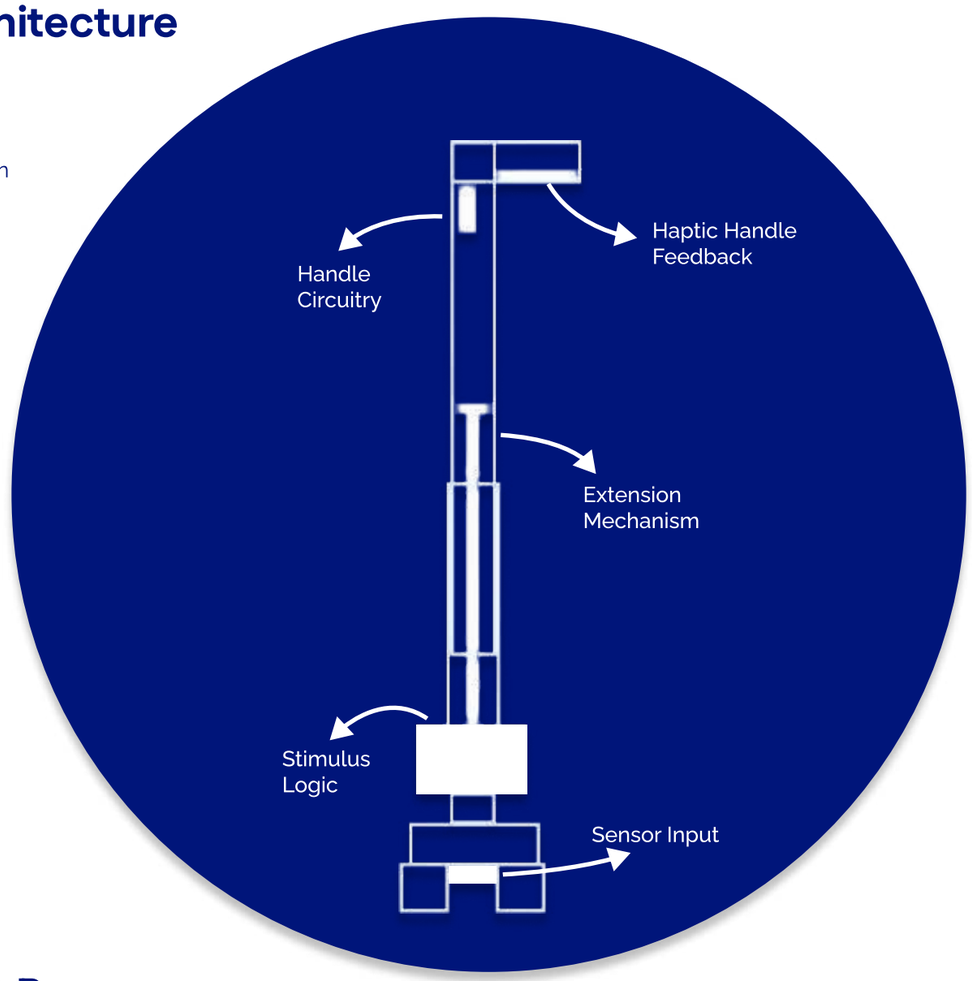
4 Part Mould

This mould consists of four parts: the two side sections form the embossing, the bottom circular section moulds the ferrule hole, and the top section incorporates features for securing the bearing and housing the battery holder.

System Architecture

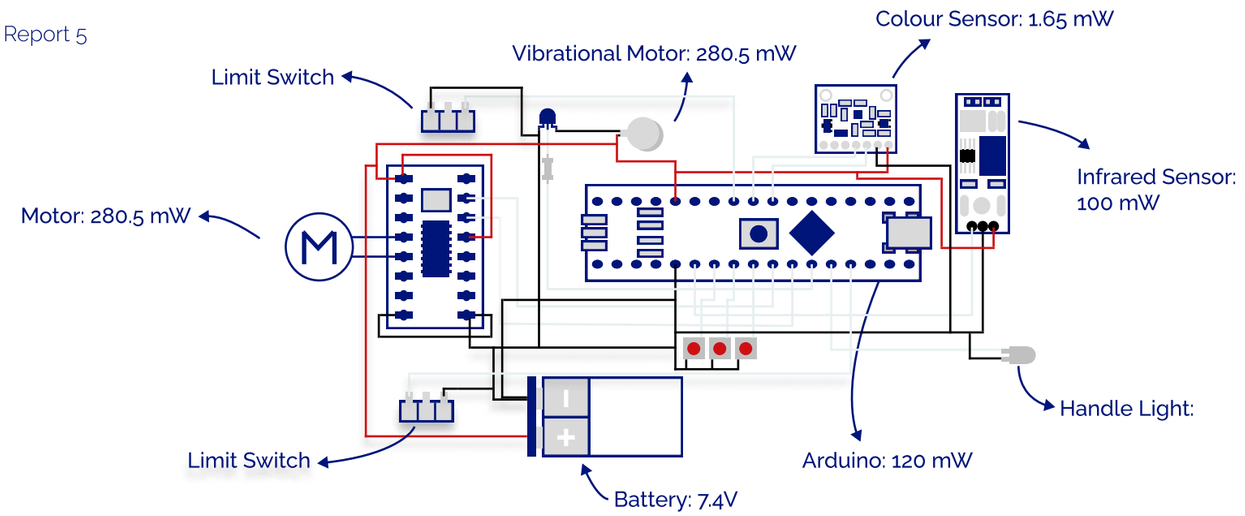
Product Architecture

The diagram shows the product architecture of Stride and portrays how information flows between the main functions of the product.

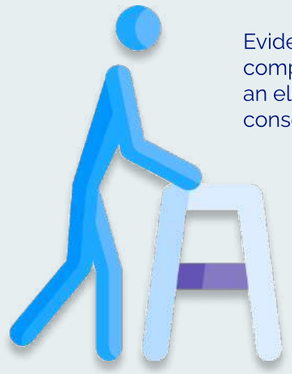


Electronics Schematic & Power

Report 5



Load Calculations | Report 5



Evidence suggests that Parkinson's patients exhibit lower body weight compared to healthy patients, of the same age. The average body weight of an elderly person is 63.4kg (males) and 55.8kg (females), therefore to be conservative, the assumed body weight on the stick was taken as 80kg. [27]

While walking, the load is taken to be 20% of the person's weight.

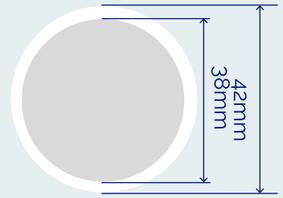
Static Load = F = 0.2 x 80 x 9.81 = 156.96 N
Safety Factor = 3.5
156.96 x 3.5 = 550

Therefore, product must be designed for 550 N.

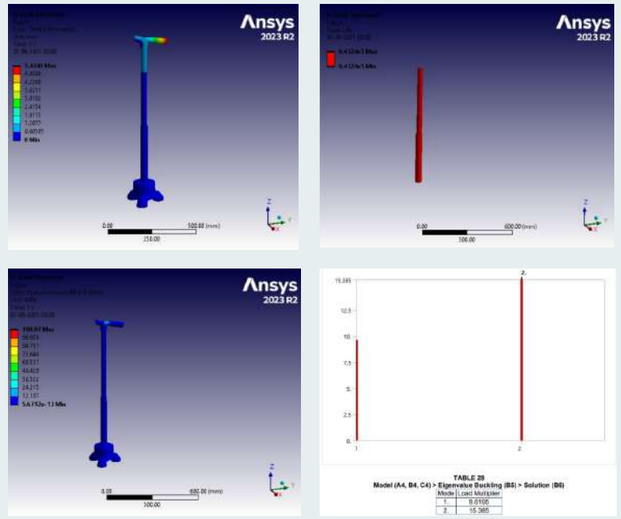
$$A = \frac{\pi (D^2 - d^2)}{4} \longrightarrow \frac{\pi (0.042^2 - 0.038^2)}{4} = 0.000251 m^2$$

$$\text{Stress} = \sigma = \frac{F}{A} \longrightarrow \frac{550}{0.000251} = 2.19 MPa$$

As 2.19MPa << 55MPa, the stick will not break.



To further test the walking stick, Finite Element Analysis was undertaken on the walking stick.



Results from FEA prove that under the typical load, the stick will not fail or buckle, proving the product is safe to use.

Product Compliance

UKCA and CE markings

Report 10.1

The UK Conformity Assessed (UKCA) and CE markings are conformity markings for all products being placed on the market in Great Britain and the European Economic Area (EEA) respectively.

International Electrochemical Commission (IEC)

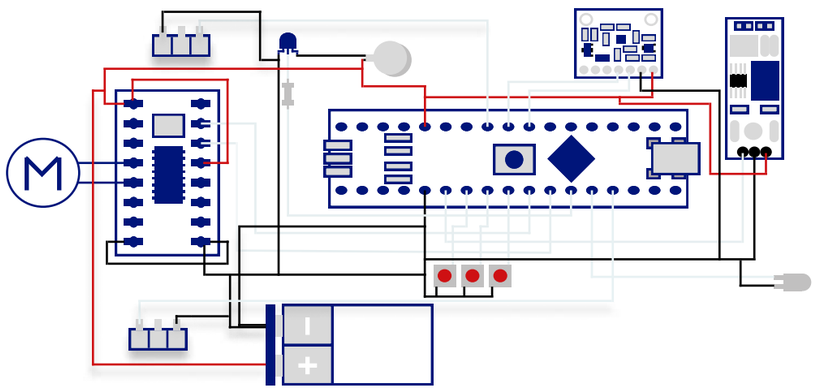
Report 10.3

IEC 60601-1 [18]

- For low-voltage devices, use double insulation (Class II) and no Y-capacitors to minimize leakage
- Require ≥ 3 mm creepage between live conductors, ≥ 4 mm to earth/ patient-contact surfaces
- Outdoor surfaces must not exceed safe touch limits.

IEC 62366-1 [20]

- Identify high-risk task: motor activation during gait freeze
- Implement UI mitigation: large button ≥ 15 mm, soft-haptic cue

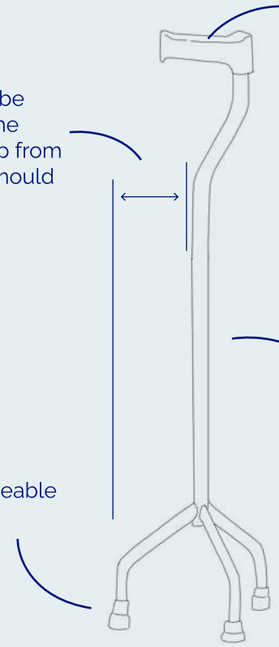


International Organization of Standardization (ISO)

Report 10.2

Requirements for assistive products for walking manipulated by one arm – ISO 11334-4 [10]

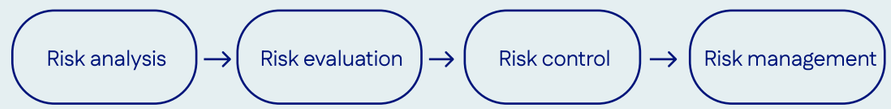
- 6.3.1 Handgrip width shall not be less than 20 mm and not more than 50 mm, unless it is an anatomic handgrip.
- 6.3.5 The frame should be designed to minimise the distance of the handgrip from the tips. This distance should not exceed 40 mm.
- 7.3.1 Shall be designed to be accessible for cleaning to prevent cross infection
- 6.3.3 Tips shall be replaceable



Risk management for medical devices – ISO 14971 [14]

Using clause 7.1 (b), risk control will be done by "protective measures in the medical device itself or in the manufacturing process."

- Insulated wires
- Mechanical and electrical fail-safe



Classification of assistive products - ISO 9999 [13]
Stride will be classified as a 12 03 16 product - Walking devices providing support and balance which have a handgrip, shaft and three or more legs with tips.

Product Assembly Process

Report 9

Total Assembly Cost	Total Assembly Time
£143.43	1 hr 30 minutes

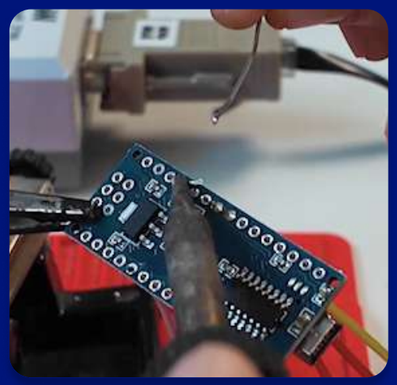
Pipe

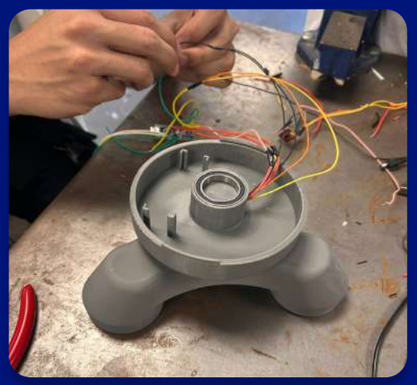




The lead screw and nesting tubes were measured and cut to size.
These pieces, along with 3D printed aligning components, were then filed and slotted into their allotted places.

Casing

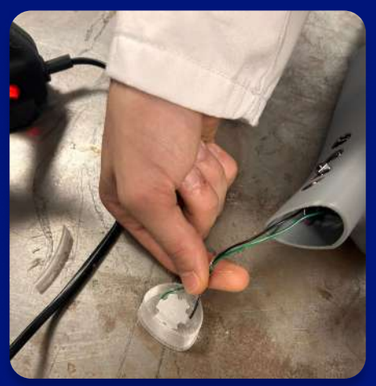





The base and casing were 3D printed at an angle for a smoother finish. The internal electronics (sensors and wires) were then soldered. Holes were drilled into the casing, base and silicone ferrule to allow wires to be fed through.

Handle





Finally, the handle was 3D printed. The buttons and lights were soldered and fed through the stick. Button caps were then glued onto the button. This handle was then secured to the stick's top.

With the usage of automated processes and machinery, it is believed that the assembly time would reduce significantly (approximately 1hr).

Handle Interface

Up

Pressing the up button drives the motor counter-clockwise, rotating the lead screw and raising the nut, which results in the extension of the Stride mechanism.

Down

Pressing the down button rotates the motor clockwise, turning the lead screw in the opposite direction, which lowers the nut and retracts the Stride mechanism.

Vibration

The vibration button manually activates the haptic feedback via the vibration motor embedded in the handle.

It was added following Dr. Tai's recommendation to provide a manual method for symptom relief.

Light

The light button toggles the front-facing handle light, providing illumination to assist the patient when walking at night or in low-light environments.

Report 4.1.1

Report 3.5.4

Visual Barriers

Problem

Freezing of Gait is a phenomenon caused by sensory overload. When PD patients see a change in flooring, a doorway, or any obstruction in their path, they consequently freeze.

Approximately **50%** of Parkinson's patients experience FoG. [33]

As the patients' duration with the Parkinson's increases, the likelihood of experiencing FoG increases significantly [34].

Detection

TCS24725 Colour Sensor: Used to check if the colour of the floor has changed (indicating a change in flooring)

Infrared Sensor: Digital output is used to measure if the stick is on the floor or not.

Response

When both the infrared and RGB sensors detect the floor and a change in flooring, this indicates a barrier.

This suggests the patient might experience a freezing episode.

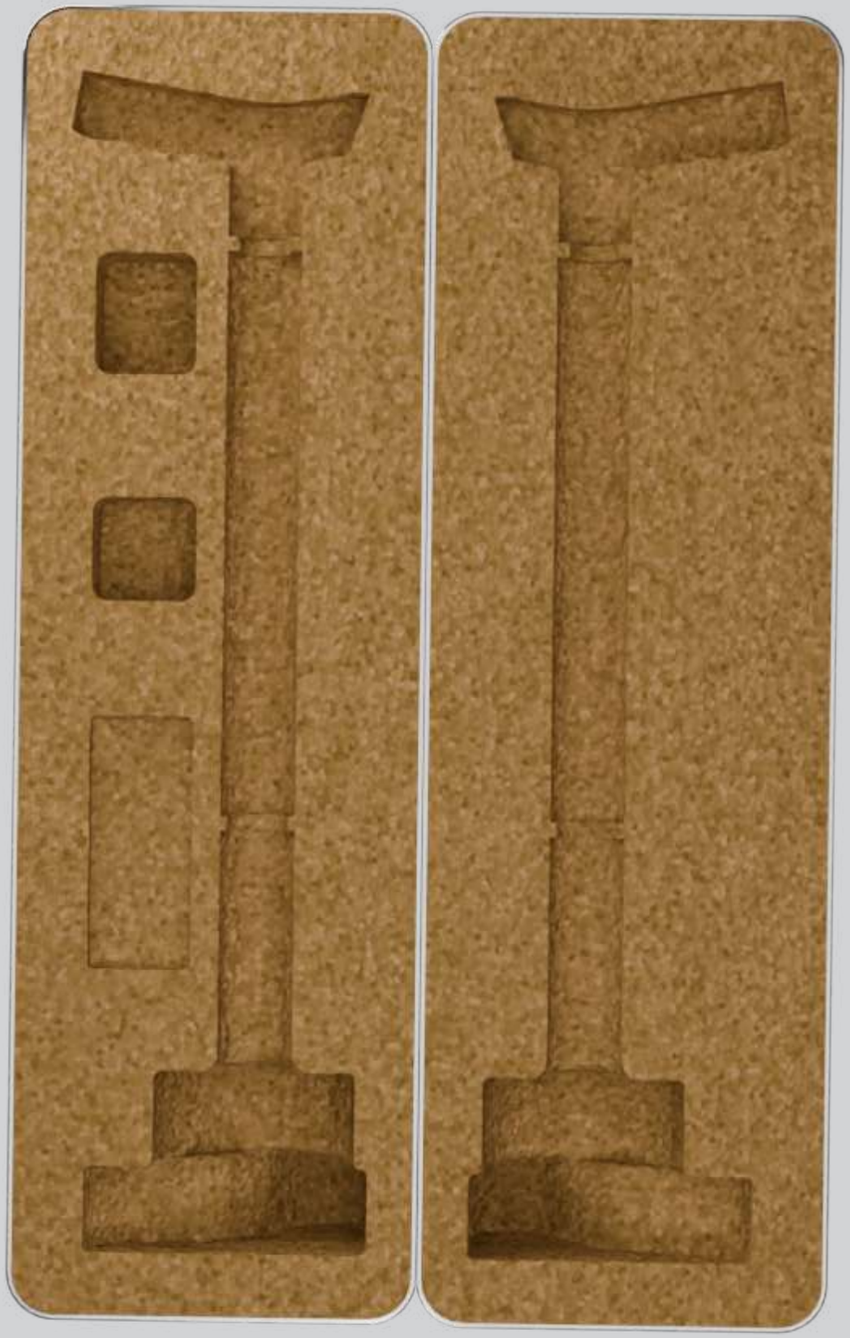
The Arduino responds by activating the vibrational motor (in the handle) to help the patient overcome the freeze.

Product Packaging

Aligning with Ottobock's brand, the packaging for Stride follows a minimalistic, sleek design, representing the companies under-arching mission of being for the people - we did not want the product to look or feel like a medical device, but instead a gift to users.

Stride comes with a charger and replaceable rubber tips, for the base, ensuring longevity of use.

Product Packaging



Design Considerations

Premium Materials

Cork and Aluminium offer a premium look and feel to the case, making it feel like a gift.

Minimal Design

It does not look like a medical device from the outside, helping users be more confident.

Reusable

The case can be reused when needed such as when travelling abroad.

Protective

The cork provides support and shock resistance to protect the walking stick.

User Guide

Readability

Large text and illustrations ensure rules and instructions are legible and understandable.

Functionality

All forms of use explained clearly and concisely, to facilitate easy understanding.

Health & Safety

All health and safety hazards clearly explained with symbols, as well as guidelines for use.

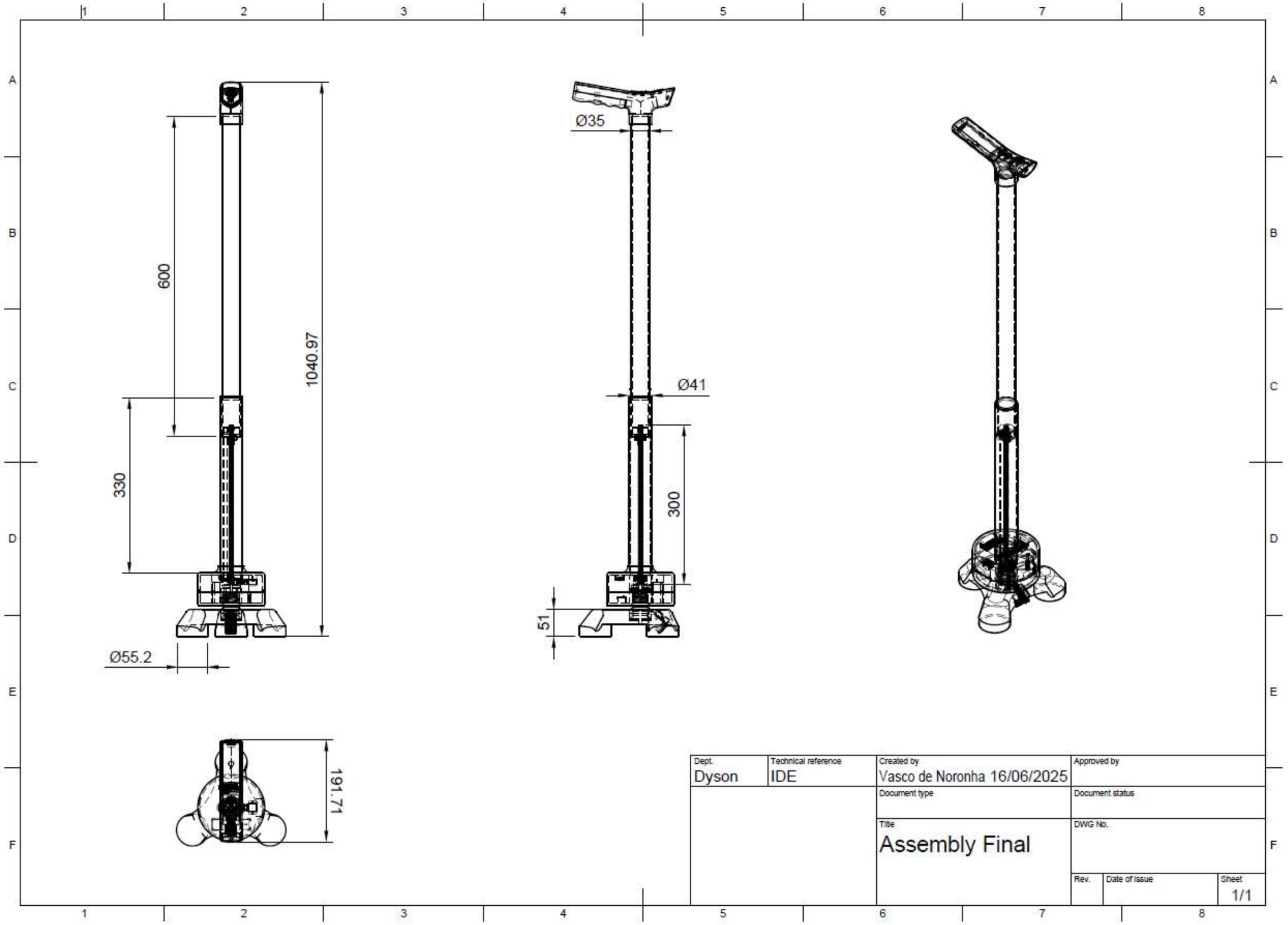
Maintenance & Repair

Routine maintenance checks and repair solutions are outlined in order to maintain high performance.

Declaration of Conformity

Shows that the product meets all relevant legal, safety, and technical standards required by authorities.

Technical Drawings

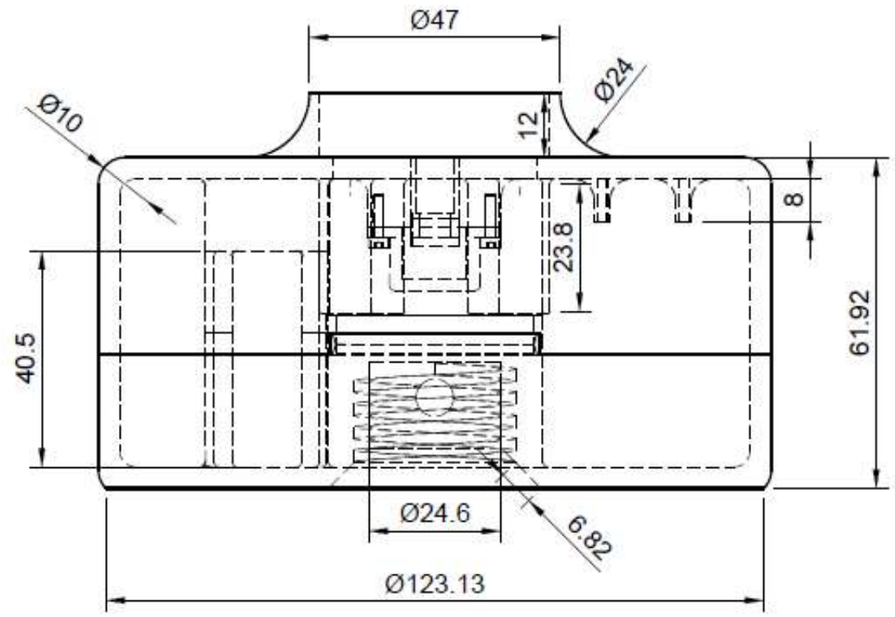


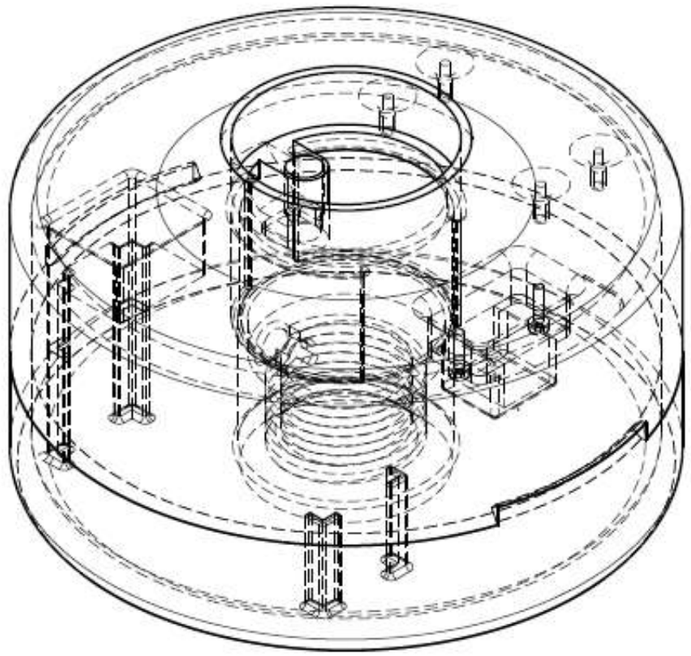
Dept.	Technical reference	Created by	Approved by
Dyson	IDE	Vasco de Noronha 16/06/2025	
		Document type	Document status
		Title: Assembly Final	DWG No.
			Rev. / Date of Issue / Sheet: 1/1

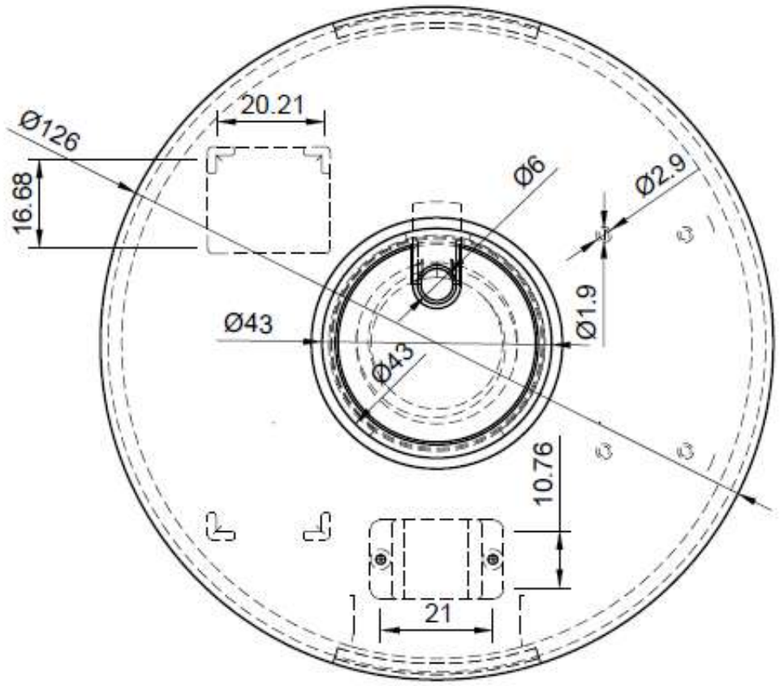
Stride.

Assembly

Technical Drawings





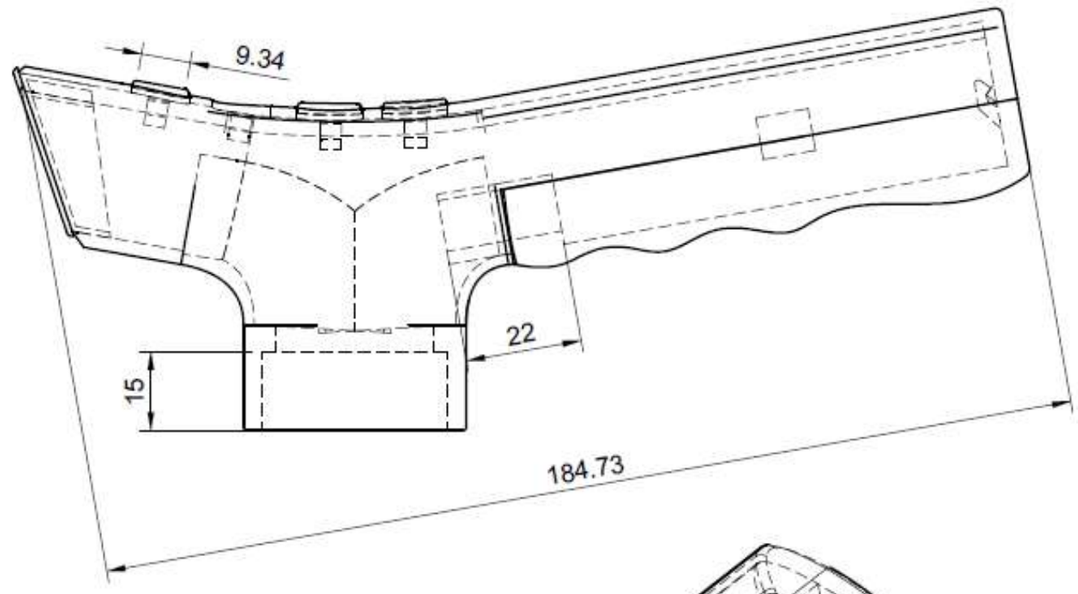


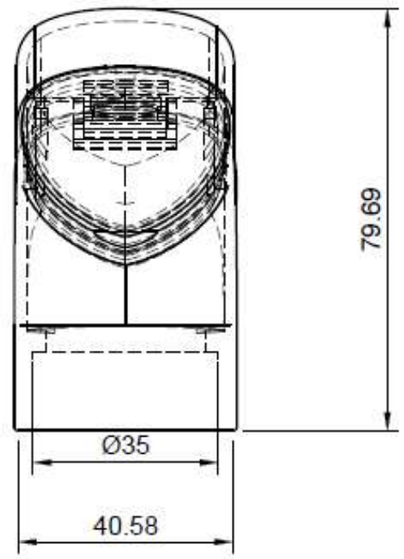
Dept.	Technical reference	Created by	Approved by
Dyson	IDE	Vasco de Noronha 16/06/2025	
		Document type	Document status
		Title: Bottom Housing 1:1	DWG No.
			Rev. / Date of issue / Sheet: 1/1

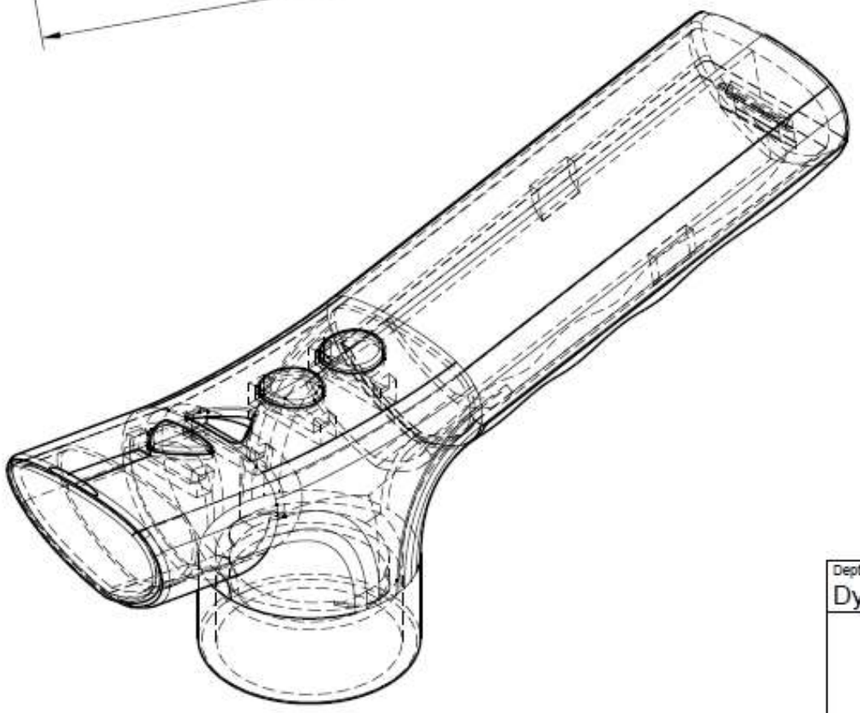
Stride.

Housing

Technical Drawings







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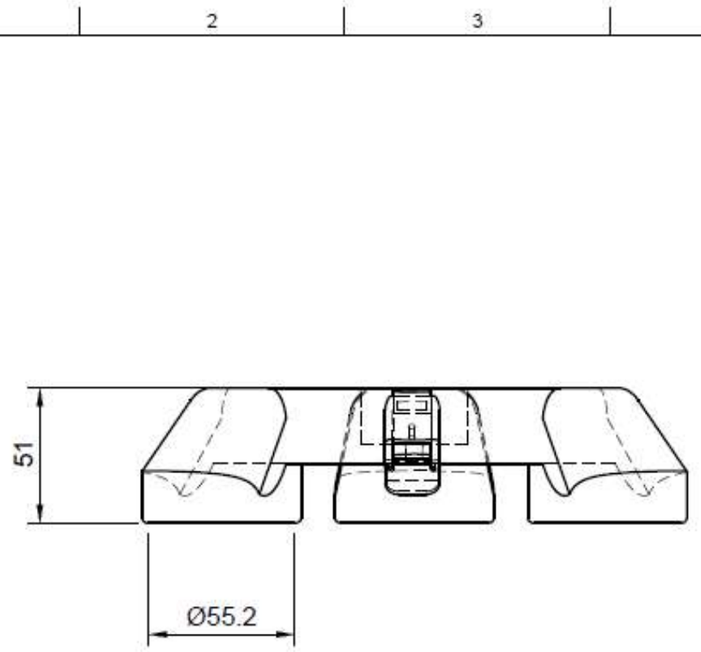
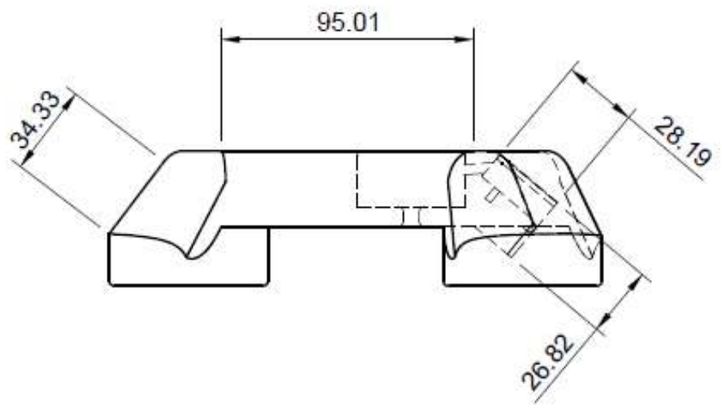
Dyson	IDE	Vasco de Noronha 16/06/2025	
		Document type	Document status
		Title: Handle	DWG No.
			Rev. / Date of issue / Sheet: 1/1

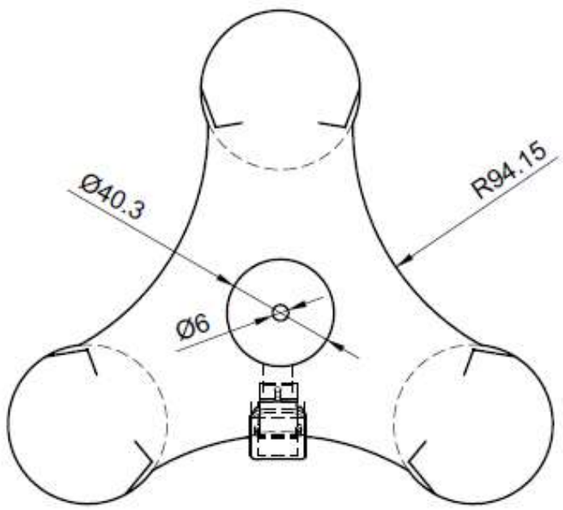
Stride.

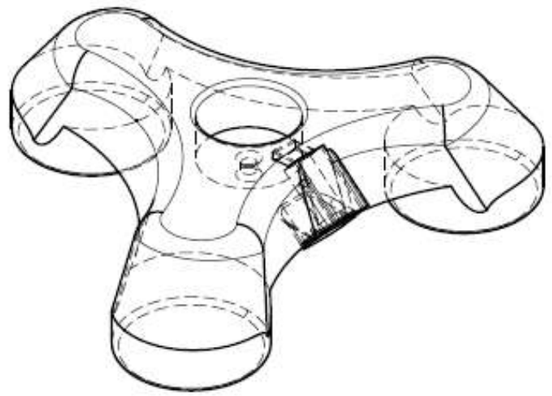
Handle

Technical Drawings







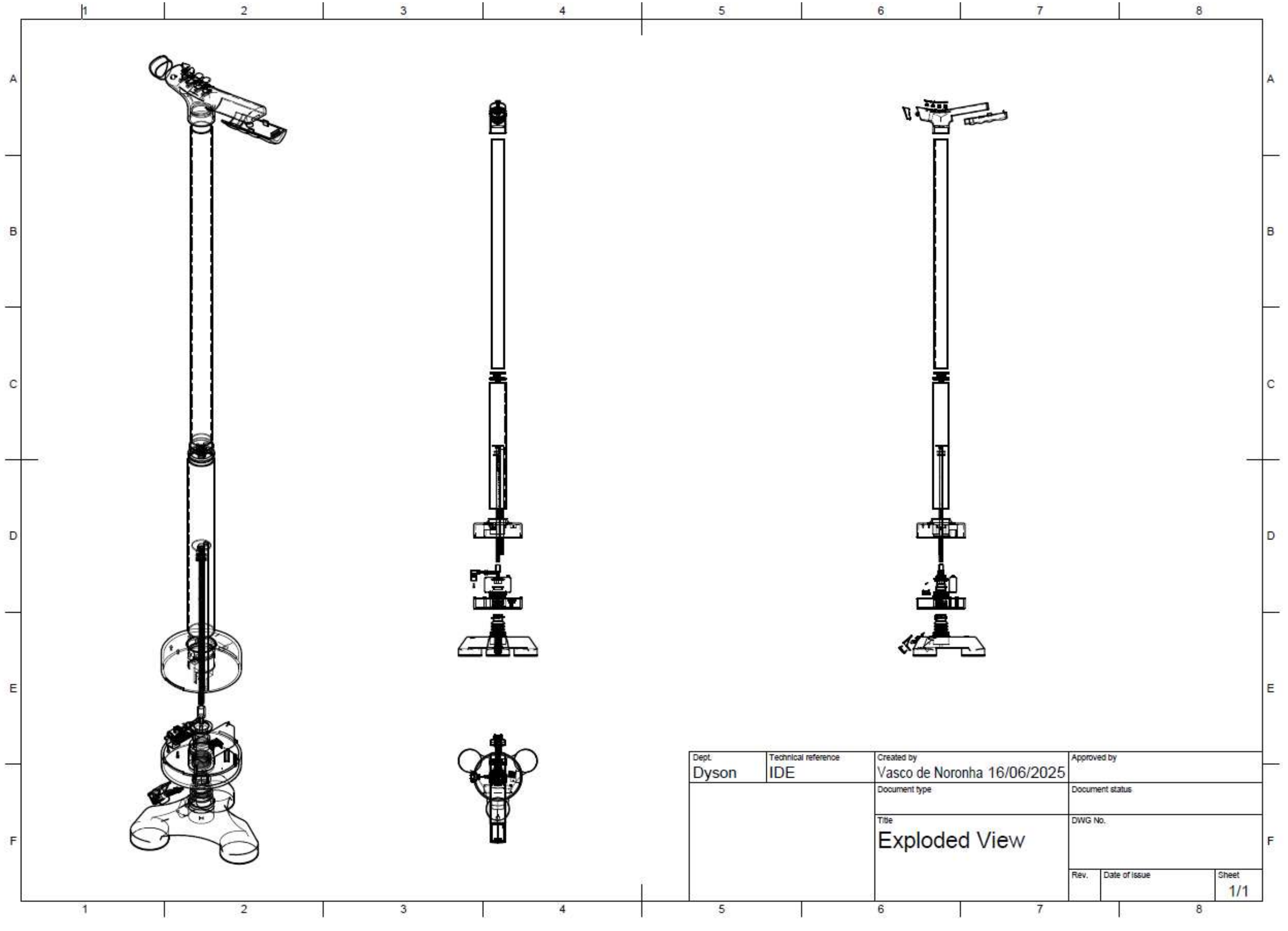


Dept.	Technical reference	Created by	Approved by
Dyson	IDE	Vasco de Noronha 16/06/2025	
		Document type	Document status
		Title: Base 1:2	DWG No.
			Rev. / Date of issue / Sheet: 1/1

Stride.

Base

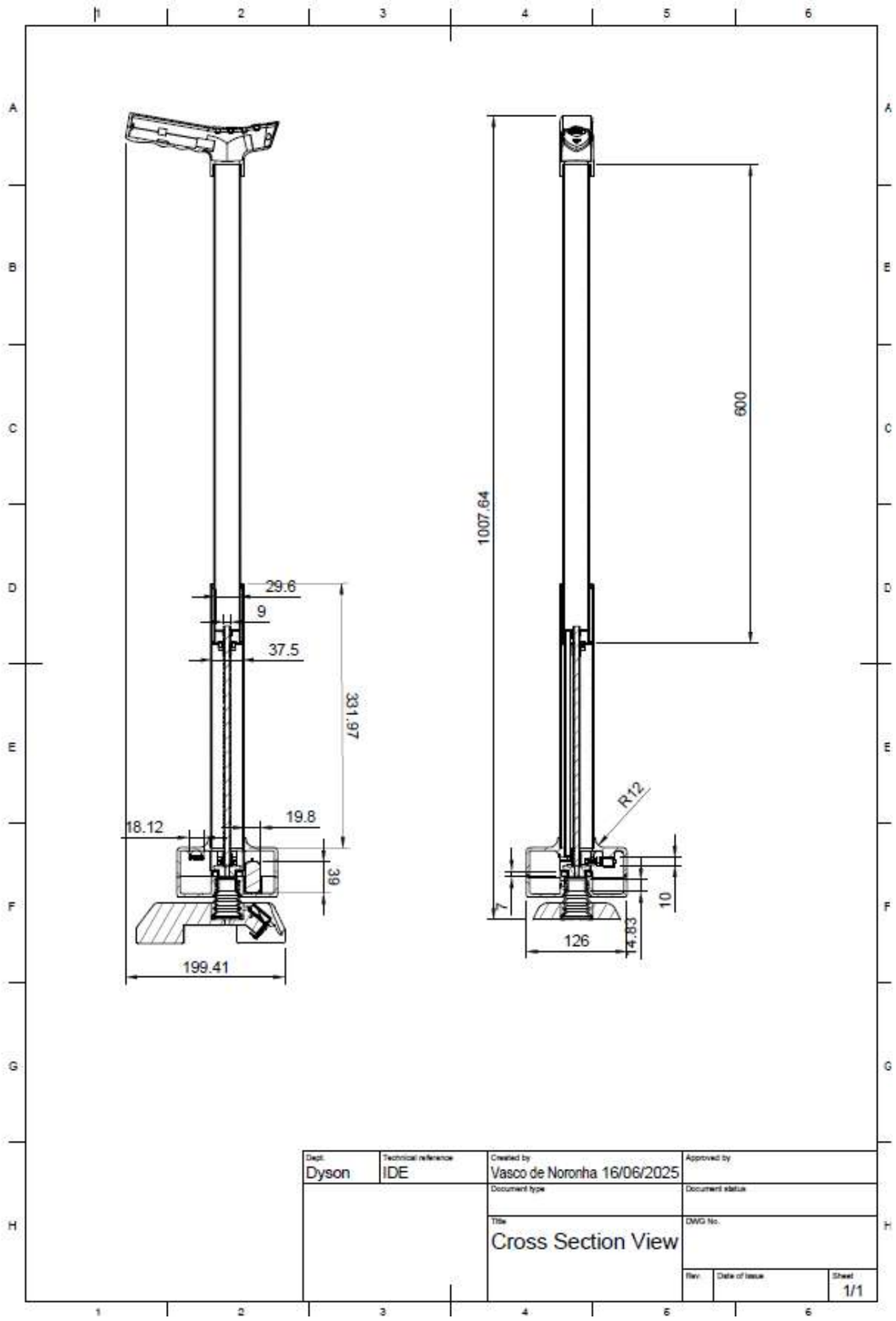
Technical Drawings



Stride.

Exploded

Technical Drawings



Bill of Materials

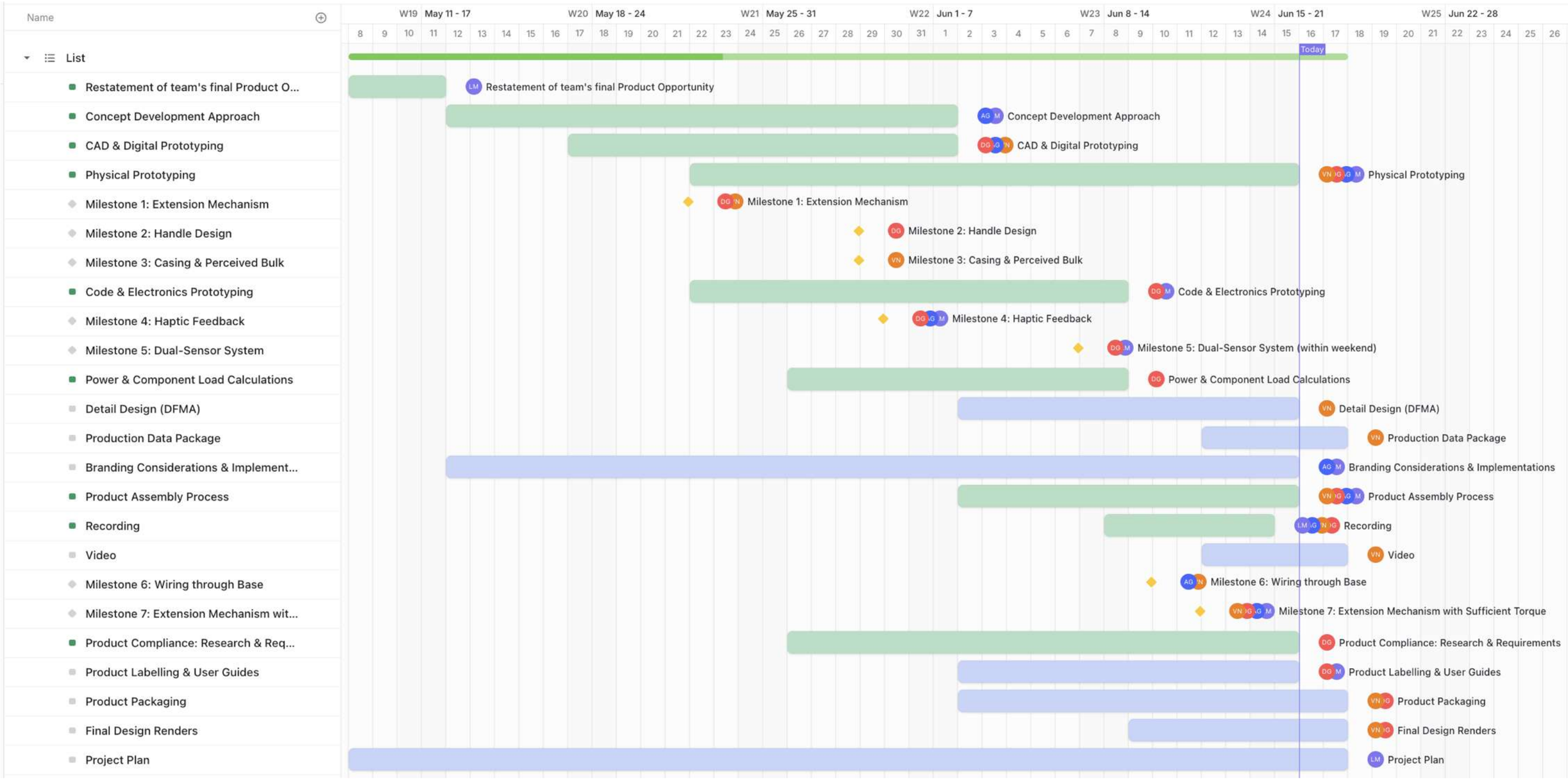
Item Name	Item Number	Procurement Details	Cost	Qty.	Material	Dimensions (mm)	Weight (g)	Assembly
Colour Module - TCS34725	E1	Amazon	8.29	1		20.5 x 20.5	3.23	Screws
Arduino Nano	E2	Amazon	13.99	1		45 x 18	7	Screws
Vibration Motor 1027	E3	Amazon	4.99	2		R5 x 2.7	8	Sticker Glue
Infrared Sensor	E4	Amazon	1.1	1		39 x 15.50	6	Screw
Lead Screw	M1	Amazon	22.49	1	Stainless Steel + Brass Nut	R8 x 300	200	Interference Fit
Pole 1	S1	Hardware Shop	6	1	PVC	OD42 x ID38 x 330	130	Interference Fit
Pole 2	S2	Hardware Shop	7.5	1	PVC	OD34 x ID30 x 660	180	Interference Fit
Bevel Gear - Large	M2	Amazon	42	1	Steel	OD15 x 12	30	Interference Fit
Bevel Gear - Small	M3			1	Steel	OD8.5 x 12	15	Interference Fit
Bearing	M4	Amazon	5.39	1	Steel	32OD x 25 ID	25	Interference Fit
N20 Gearmotor	E5	Amazon	9.99	1		34 x 12 x 10	15	Holder screwed in
Light	E6	Amazon	0	1			2	Glue
Bottom Ferrule	S3	Amazon	10	1	Silicone	R12.5	10	Glue + Screw
Battery 4LR44	E7	Amazon	0.7	1			24	Snap fit
Push Buttons	E8	Amazon	0	4		6 x 6 x 3	4	Glue
H-Bridge	E9	Amazon	4.5	1		15 x 18	6	
Stable Rod	M5	Amazon	6.49	1	Stainless Steel	7mm OD x 300mm L	50	Interference Fit
Handle	S4	Injection Mould		1	ABS	40 x 200	60	Interference Fit
Handle Electronics Cover	S5	Injection Mould		1	ABS	40 x 100	10	Snap Fit
Handle Buttons	S6	Injection Mould		4	ABS	20 x 20	4	Glue
Light Cover	S7	Injection Mould		1	Clear PLA	40 x 50	20	Interference Fit
Base Electronics Housing Upper	S8	Injection Mould		1	ABS	126OD x 37 mm	50	Snap Fit
Base Electronics Housing Lower	S9	Injection Mould		1	ABS	126OD x 37 mm	50	Screw
Bearing-Gear Connector	M6	Injection Mould		1	ABS	OD25 x 10	9	Interference Fit
Motor-Gear Connector	M7	Injection Mould		1	ABS		1	Interference Fit
Pipe Seal	S10	Injection Mould		1	ABS	OD42	4	Interference Fit
Nut-Pipe Connector	M8	Injection Mould		1	ABS	OD36	3	Interference Fit
Gear-Lead Screw Connector	M9	Injection Mould		1	ABS	OD10	4	Interference Fit
Sensor Casing	S11	Injection Mould		1	ABS	21 x 40	14	Screw
Base	S12	Injection Mould		1	ABS	155 x155 x mm	200	Glue
Transistor	E10			1			1	
Resistor	E11			1			N/A	
Connectors								
M3 Nuts and Bolts	C1			3	Steel		6	
M2 Screws	C2			8	Steel		7	

Stride.

Cross Section

Gantt Chart

Video Link :https://www.youtube.com/watch?v=gEuQs7CLnwU



Hybrid Approach

Combining Agile-inspired iterative design with traditional Gantt chart planning to enable flexibility with recommended deadlines and accountability.

Team Contributions

- AG Amelia Gustave
- LM Lara Merican
- DG Devansh Goel
- VN Vasco de Noronha

Milestones

Iterative improvements were made in response to testing outcomes, with each milestone building towards a more refined and functional final product.