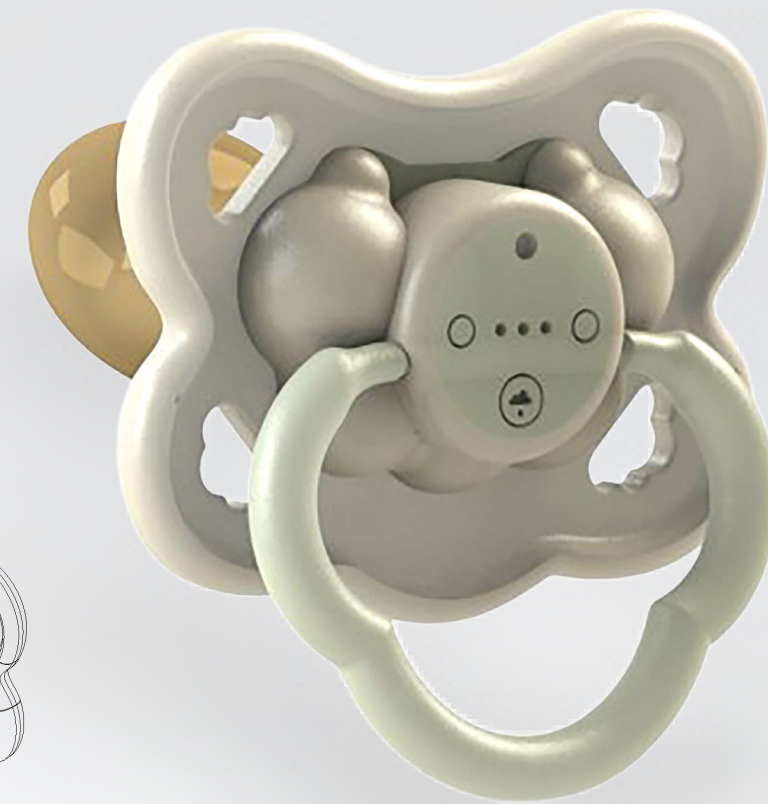
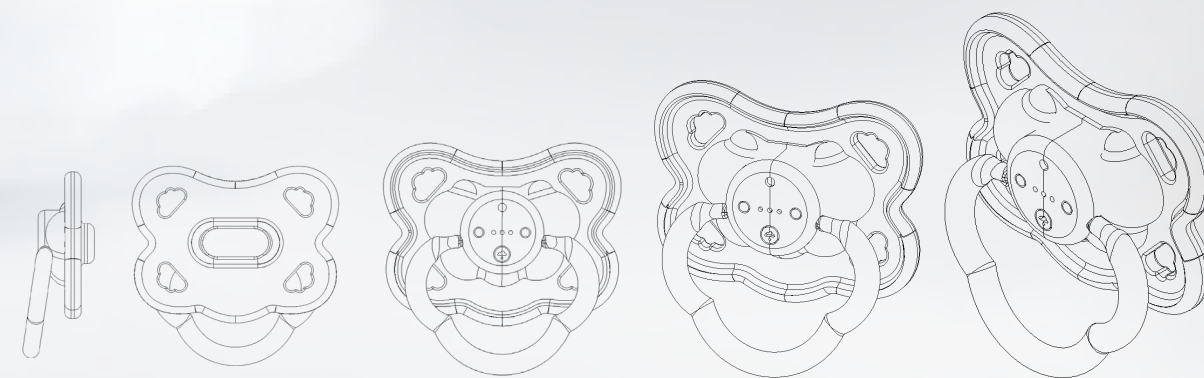




Ceila© by Lara Finlay - relieving NHS pressure:
a smart pacifier that enables early monitoring,
reduces hospital visits and saves
healthcare resources.

CEILA

Smart Tech Infant Pacifier
Lara Finlay . Major Project
April 2025



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EMPATHISE

PRIMARY & SECONDARY RESEARCH

This chapter focuses on understanding user needs by exploring the challenges faced by parents, healthcare providers, and the NHS.

Through research and stakeholder analysis, it identifies key pain points in paediatric healthcare, ensuring the smart infant pacifier is designed to improve accessibility, reduce costs, and align with real-world needs.

Child healthcare represents a significant portion of NHS activity. Conditions like fever, dehydration, respiratory infection, colic, and reflux are among the most common reasons for infant hospital visits - yet many are treatable at home with timely reassurance or basic monitoring. service strain and resource demands are a continual challenge.

Research Constraints

1 **Limited Access to Recent Data -** Many NHS financial reports and case studies are outdated or restricted, limiting the depth of insights and forcing reliance on less specific sources.

2 **Generalization of Findings -** Much of the secondary research provides broad trends, making it harder to capture specific financial challenges within different NHS demographics.



INFANT MORTALITY
RATE UK

3.6
deaths per
1,000
live births



NEONATAL DEATHS
(FIRST 28 DAYS)

Roughly
75%
of infant
deaths in
the UK
occur within
the first 28
days of life



GLOBAL PERSPECTIVE
WORLDWIDE

2.3
million
babies
died in the
first month
of life in
2021

Roughly 6,400
newborn deaths
per day.

CURRENT ISSUES

Financial strain of
Child Healthcare
on the NHS

Child healthcare represents a significant portion of NHS activity. Conditions like fever, dehydration, respiratory infection, colic, and reflux are among the most common reasons for infant hospital visits — yet many are treatable at home with timely reassurance or basic monitoring. service strain and resource demands are a continual challenge.

Preventability of Early Infant Mortality

WHO estimates that nearly 80% of neonatal deaths are preventable with simple interventions such as:

- Early detection of infection or fever
- Timely medical access
- Basic at-home monitoring

Common Preventable Causes

Infection, low birth weight, and hypothermia are leading preventable causes of early infant death globally and in underserved areas of the UK.

50%

Of infant emergency visits are due to minor infections or symptoms that don't require clinical intervention. (Source: NICE Guidelines, 2022)

82%

Of parents say they would feel more confident managing symptoms at home if they had access to health-monitoring tools or real-time guidance. (Source: Parent Survey UK, 2023)

X2

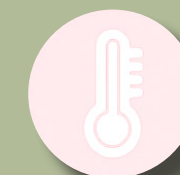
As high infant mortality rates in the most deprived areas of England compared to the least deprived areas.

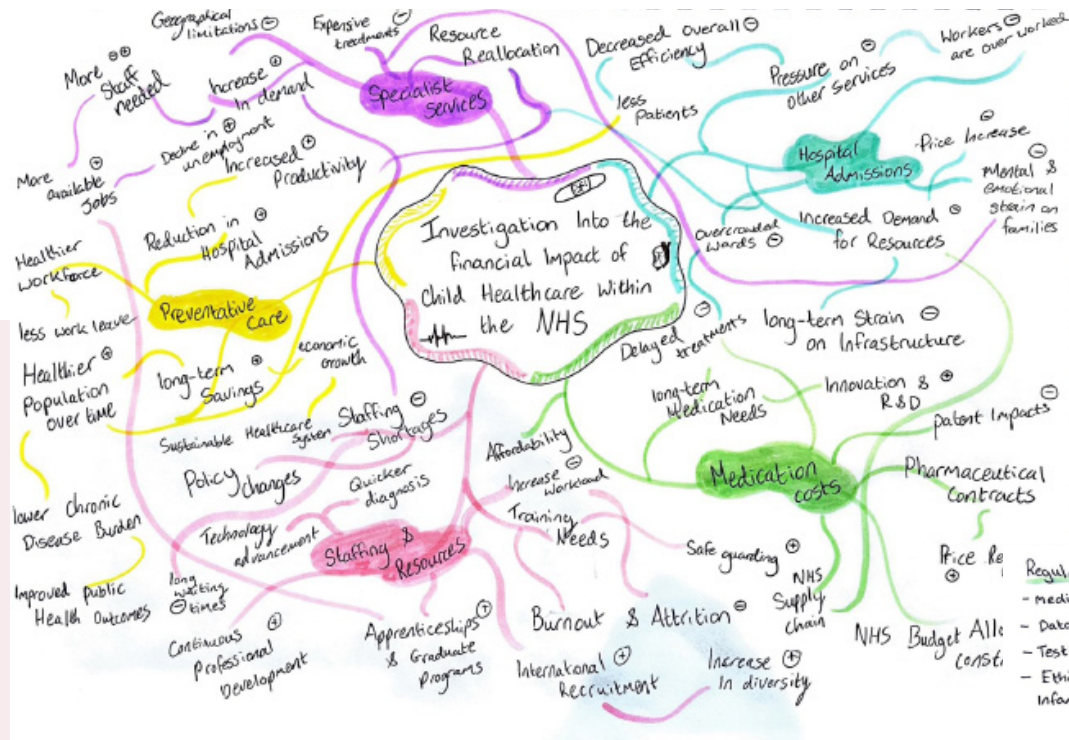
80%

Nearly 80% of neonatal deaths are preventable with simple interventions like early detection of infection or fever and basic at-home monitoring.

Early infant mortality refers to children under the age of one dying.

SYMPTOM DETECTED ➡ MONITORING AT HOME ➡ REDUCED A&E VISIT





INITIAL BRAINSTORMING



Initial Problem Mapping

The first mind map was developed to explore the broad financial impacts of child healthcare on the NHS. By breaking down areas such as medication costs, hospital admissions, preventative care, staffing shortages, and specialist services, I was able to identify key challenges straining both healthcare delivery and funding. This exercise highlighted the need for solutions that could prevent hospital admissions, improve resource allocation, and create long-term savings — setting a strong foundation for defining the focus of my project.

Concept Development Mapping

The second mind map focused on translating the initial problem insights into an actionable product strategy. Here, I explored areas such as regulatory compliance, design engineering, future scalability, user experience, and market positioning.

Value of Early Mapping

Together, these mind maps formed a critical early-stage thinking tool, helping me navigate complex healthcare issues and refine my project scope. They allowed me to visually connect problems with potential solutions.

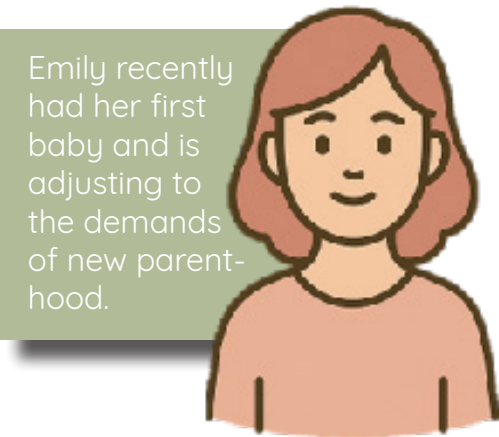


INTERVIEWS

PRIMARY RESEARCH

Interview 1:

Emily – First-Time Mum, Age 29



Emily recently had her first baby and is adjusting to the demands of new parenthood.

“I’m constantly checking if my baby is too hot or too cold—something that tells me that instantly would be amazing.

I don’t want anything bulky or techy-looking in my baby’s mouth. It needs to feel like a normal dummy.

If I have to charge it every day, I’ll forget. Maybe something with long battery life or alerts would help.

“We get far too many unnecessary visits for non-serious issues that could’ve been caught earlier at home.

If something like this could track trends—like temperature over time—it might reduce those visits.

It would need to be safe, certified, and easy for parents to understand. Anything unclear could cause more panic.



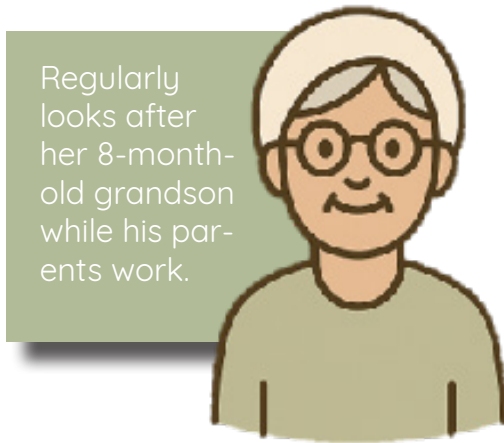
Works in a busy NHS children’s A&E department, delivering care in a fast-paced environment.

Interview 2:

Dr. Ahmed - NHS Paediatrician

Interview 3:

Sue – Grandmother & Regular Carer



Regularly looks after her 8-month-old grandson while his parents work.

“Honestly, I’m not great with apps, so if it needs a phone to work, it has to be really straightforward.

I’d love a pacifier that gives me peace of mind without needing to do much.

It shouldn’t beep randomly or flash too much—it might worry the baby.

01

Emily’s insights reveal the emotional vulnerability and high alertness that new parents often feel. She emphasized the importance of immediate reassurance about temperature, the need for the product to feel like a familiar, non-intrusive dummy, and raised concerns about the practicality of daily charging, suggesting a solution that supports long battery life or smart alerts.

02

Dr. Ahmed highlighted the systemic strain caused by unnecessary A&E visits, noting how early detection tools could relieve NHS pressure. He stressed the value of trend tracking (e.g. temperature over time) as a diagnostic aid and insisted on the need for safety, certification, and clarity to avoid misinterpretation or added anxiety for parents.

03

Sue’s interview highlights the importance of simplicity and accessibility in the product’s design. As a regular carer who is less confident with technology, she values simplicity and needs a pacifier that provides reassurance with minimal interaction, avoiding overwhelming visuals or sounds that could disturb the baby. This insight supports the importance of intuitive, non-intrusive design for multi-generational use.

Start



Parents sit anxiously by crib

Pain Points:

- Lack of medical knowledge or tools to assess baby's health
- Uncertainty about what's "normal" behaviour for infants

Solution:

Ceila introduces passive, continuous monitoring from a familiar object — the pacifier — offering real-time reassurance are due to minor infections.



Mother panics over baby's breathing

Pain Points:

- Baby's breathing sounds irregular during the night
- No way to know if symptoms are serious or harmless

Solution:

Ceila tracks breathing and temperature, alerting only when necessary and reducing midnight panic infections.



Parents arrive at A&E waiting area

Pain Points:

- Long NHS wait times
- Emotional toll of being surrounded by other sick children
- Guilt over possibly overreacting

Solution:

Ceila prevents unnecessary A&E visits by supporting confident, informed decisions at home.

Paediatrician reassures them

Pain Points:

- Visit was unnecessary, wasting NHS time and adding stress
- Parents feel unsure if they did the right thing

Solution:

Ceila provides trend tracking and simple symptom guidance so parents know when action is really needed

Mother sees ad for smart pacifier

Pain Points:

- No trusted tool to distinguish normal vs. abnormal symptoms
- Overload of advice online

Solution:

Ceila offers a certified, easy-to-use solution already shaped like a dummy — familiar and reassuring

Next time, she checks the app

Pain Points:

New situation with baby stirring again Previously, this would've led to panic

Solution:

Now, she simply opens the Ceila app to calmly check live data without waking her partner or rushing to A&E



A Mother & Father sit by their newborn's crib, watching anxiously as their baby sleeps.



In the middle of the night, the baby's breathing seems irregular. The mother panics, waking the father.



The Parents arrive at the paediatrician's hospital where other worried parents & sick children fill the waiting area.



A Paediatrician finally examines the baby & reassures the parents that the symptoms are normal for high-risk babies.



Back home, the mother sees an ad for a smart infant pacifier that tracks breathing, temperature & heart rate.



A few nights later, the baby stirs in their crib, instead of panicking, the mother checks the app.



Overtime, the parents grow more confident in managing their baby's health with real-time data.



In the end, the baby grows healthier & safe. And the NHS has a reduce in unnecessary hospital visits, saving resources & time.



Finish

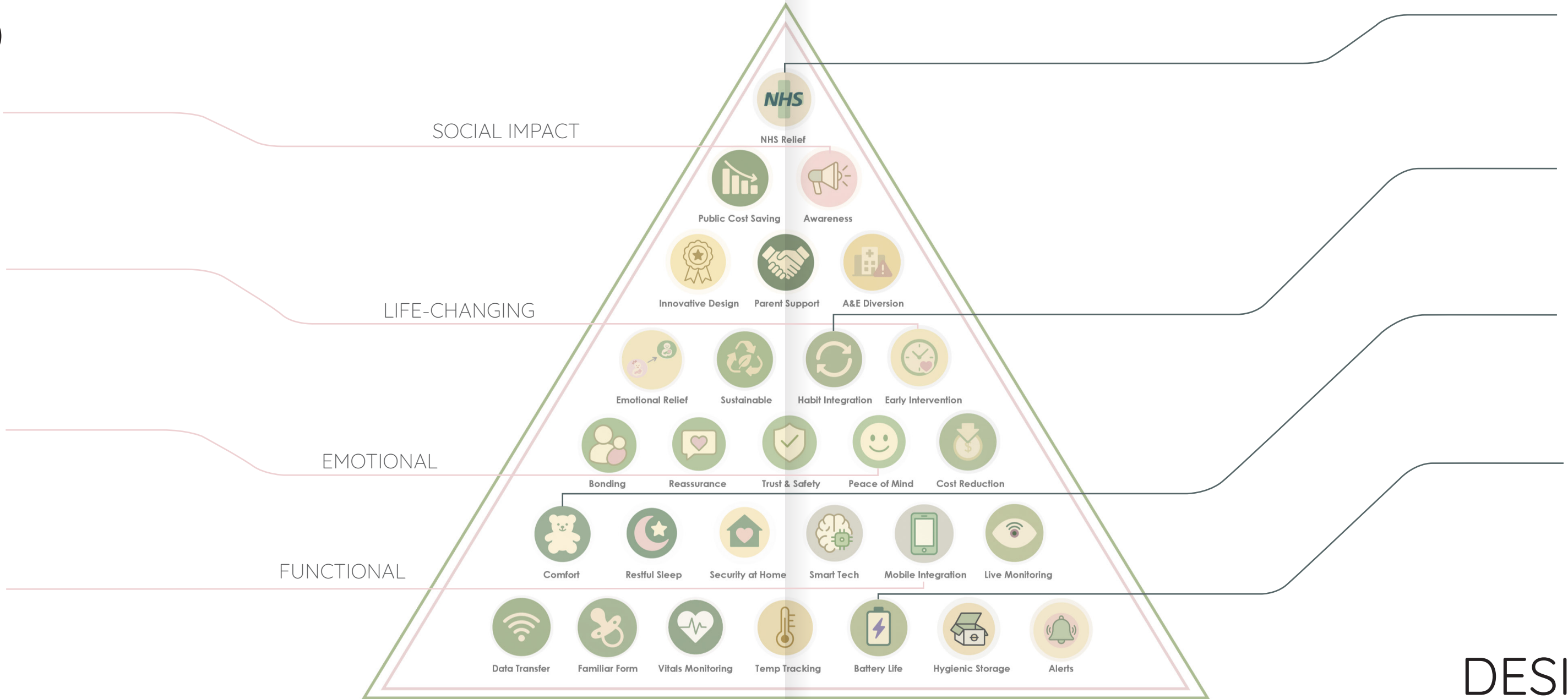
VALUE PYRAMID

Raising Awareness
Raises public and professional awareness around preventable infant health issues and NHS strain.

Early Intervention Support
Enables earlier identification of health concerns, potentially preventing emergency visits or escalation.

Emotional Reassurance
Reassures anxious caregivers by offering non-invasive, constant insight into their baby's wellbeing.

Remote Access to Reassurance
Provides parents with instant access to their baby's vitals from anywhere, reducing uncertainty in real time.



DESIGN INTENTIONS

ENTHOGRAPHY

PRIMARY RESEARCH

- 01

Conversations with parents I know:

I spoke with two new parents (family friends) who shared common worries around fevers and crying, often unsure when to seek emergency help. One admitted visiting A&E purely for peace of mind.
- 02

Online forum research:

Platforms like Mumsnet and Reddit revealed how often parents seek reassurance online, highlighting patterns of guilt, hesitation, and NHS over-reliance.
- 03

NHS admission data and commentary:

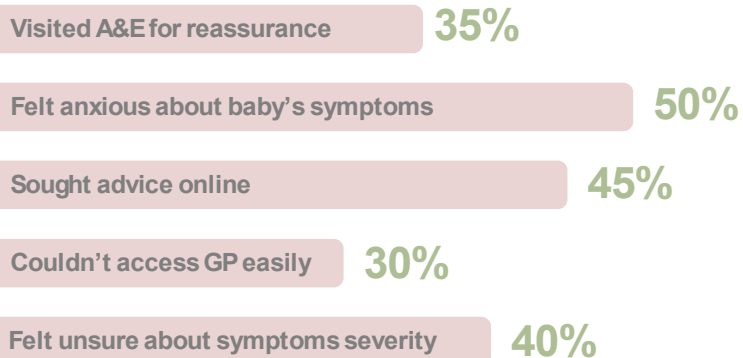
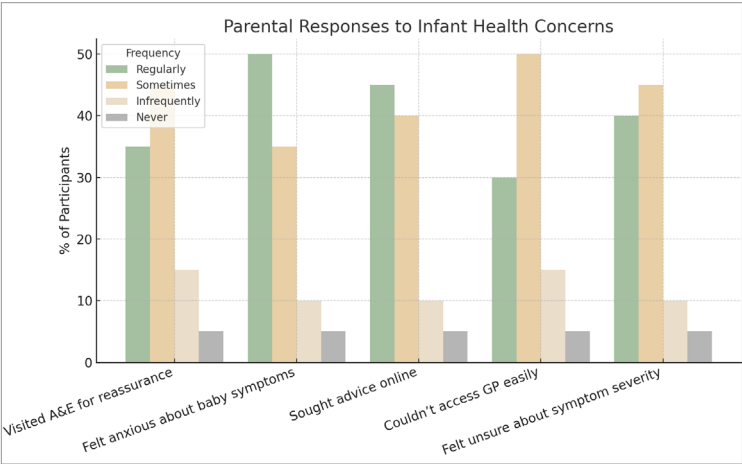
Articles and comment sections showed that many parents struggle to access GPs, often turning to A&E as a last resort.
- 04

Triggers for escalation:

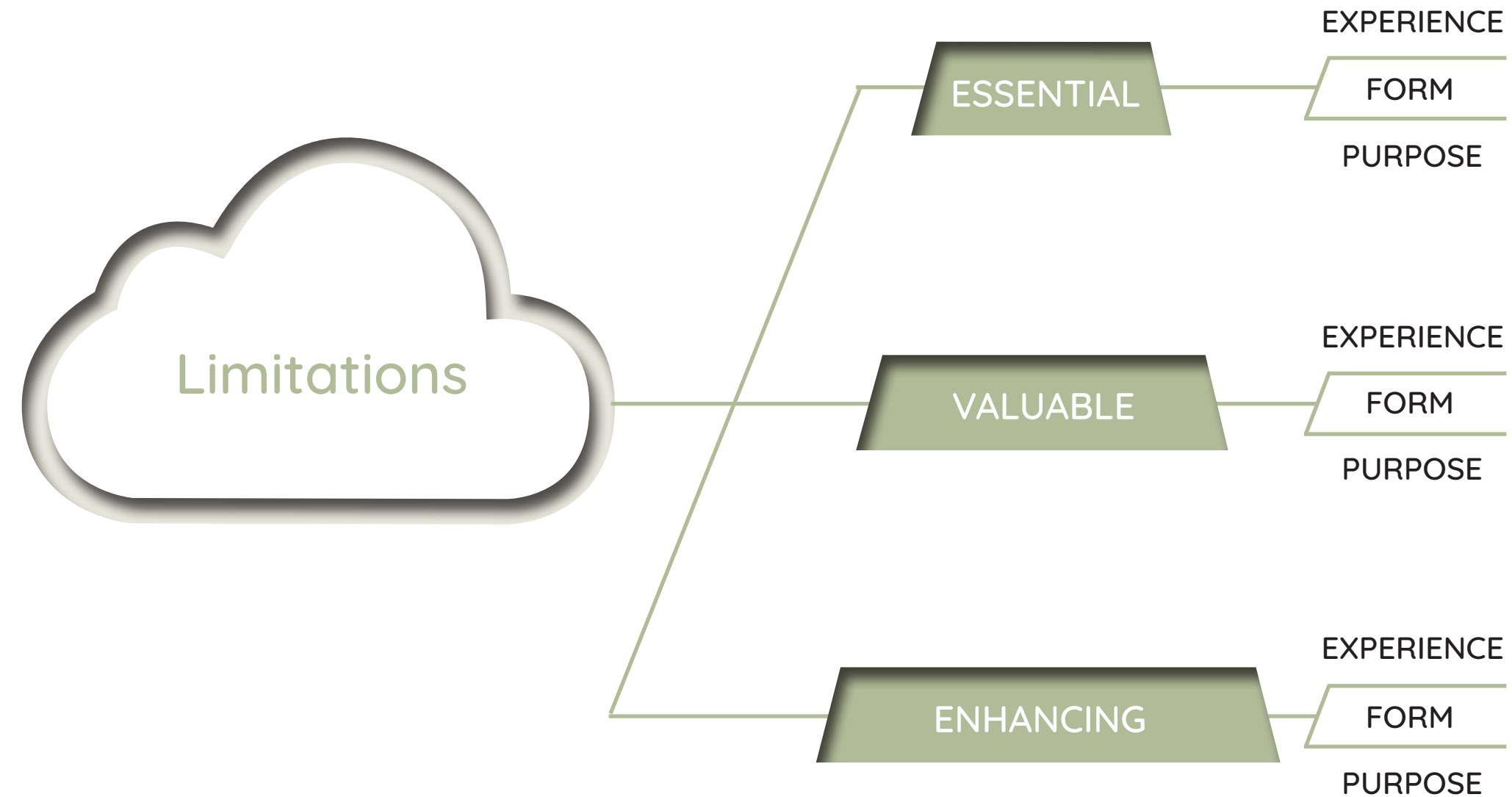
Parental stress and uncertainty peak at night or weekends, when support services are harder to reach.
- 05

Emotional undercurrent:

Across all sources, themes of panic, self-doubt, and helplessness consistently shaped how Ceila was designed to support rather than judge.



DESIGN REQUIREMENTS



The product must provide real-time reassurance to parents by visually and digitally communicating infant vitals clearly and intuitively.

It must evoke trust, emotional safety, and simplicity to reduce unnecessary NHS strain.

It must be baby-safe, hygienic, and familiar in form to avoid rejection during distress.

Should support parents during peak stress times (e.g. nights/weekends) by providing consistent information even when NHS services are less accessible.

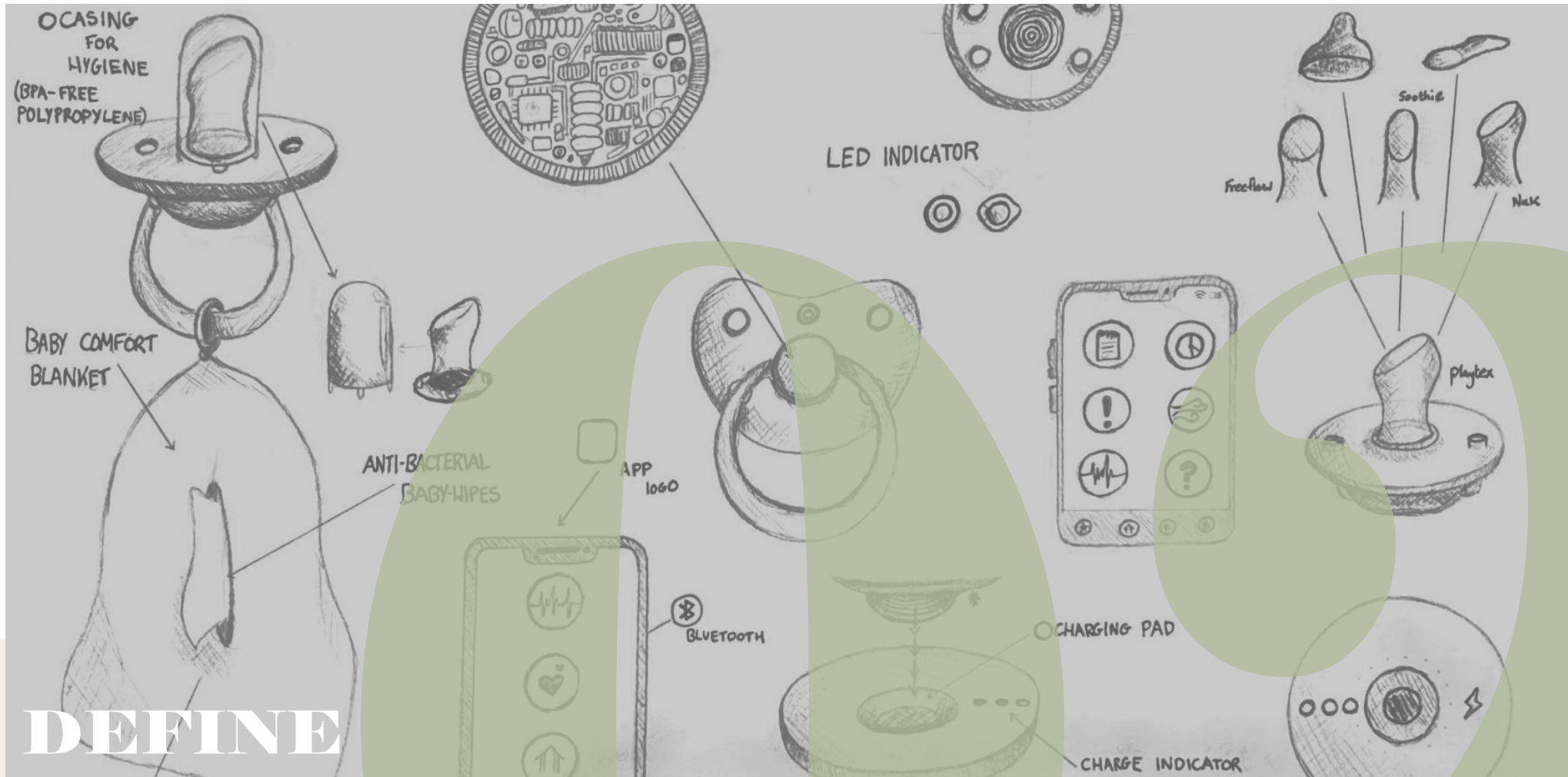
Should blend seamlessly into home and parenting routines through passive monitoring and calming aesthetics.

Should collect useful, secure data to aid future GP consultations or professional care if needed.

Could offer app-based peer support, group chat features, or general parental health news to reduce isolation.

Could integrate gamified tips, education, or mood-based UI to enhance emotional confidence and habit-building.

Could introduce adaptive light/sound functions to gently support bedtime and early stress cues.



INSIGHT ANALYSIS & PROBLEM FRAMING

This chapter narrows the focus by translating research insights into a clear, actionable design problem. Building on the emotional and systemic challenges identified in the empathise phase, it defines the key opportunity: to create a smart infant pacifier that empowers caregivers to confidently monitor early symptoms at home.

By analysing recurring patterns in stakeholder feedback and NHS service data, this stage clarifies the design brief — addressing gaps in at-home reassurance, reducing avoidable A&E visits, and easing the pressure on overstretched paediatric services. It sets the foundation for a targeted, human-centred design response grounded in real-world needs.

Defining Challenges

1 **Converging Perspectives –** Balancing the needs of both parents and healthcare professionals revealed differing priorities, making it essential to define a solution that bridges emotional reassurance with clinical reliability.

2 **Scope Prioritisation –** With many overlapping issues in child healthcare, narrowing the problem space required careful selection of what would deliver the most impact within a single, focused product.

HOW MIGHT WE... QUESTIONS



How might we...

How might we reduce unnecessary A&E visits by empowering parents to monitor their baby's health at home?



How might we...

How might we support carers with varying levels of tech confidence in using health-monitoring tools?



How might we...

How might we provide reassurance to first-time parents through simple, intuitive design?



How might we...

How might we ease the burden on NHS paediatric services through preventative, accessible interventions?



How might we...

How might we design a pacifier that feels familiar and comforting, while also integrating subtle smart technology?



How might we...

How might we build trust in a product that tracks sensitive data, without overwhelming the user?



POV Statements:

- ① Rachel, a first-time mother of a high-risk infant, needs a reliable way to monitor her baby's breathing because she constantly worries about missing signs of distress.
- ② Rachel needs a solution that reduces unnecessary hospital visits because she has to often seek reassurance from doctors, which takes up NHS resources.
- ③ Rachel needs a device that is simple and easy to use because she is sleep-deprived and struggles with complex technology.
- ④ Rachel needs a non-invasive monitoring system because she wants to ensure her baby's comfort while tracking vital signs.
- ⑤ Rachel needs a way to distinguish between normal and concerning symptoms because she lacks medical knowledge and fears misjudging her baby's condition.

How Might We ...

- ① How might we design a pacifier that monitors an infant's health without causing discomfort?
- ② How might we provide real-time, easy-to-understand alerts for parents to reduce unnecessary anxiety?
- ③ How might we integrate a mobile app that reassures parents with accurate health insights?
- ④ How might we minimise false alarms so that parents only act when necessary?
- ⑤ How might we help parents differentiate between normal infant breathing & serious issues?
- ⑥ How might we ensure the pacifier is safe, hygienic & suitable for different infant facial structures?
- ⑦ How might we design the system to complement NHS care & reduce unnecessary hospital visits?
- ⑧ How might we educate first-time parents on infant health through an accessible platform?

POV + HMW
DEVELOPMENT

POV STATEMENTS



1

REASSURANCE IN UNCERTAINTY

A new parent of a vulnerable infant needs a way to confidently monitor their baby's health at home because they often feel uncertain about recognising symptoms



2

SIMPLIFYING CAREGIVING ROUTINES

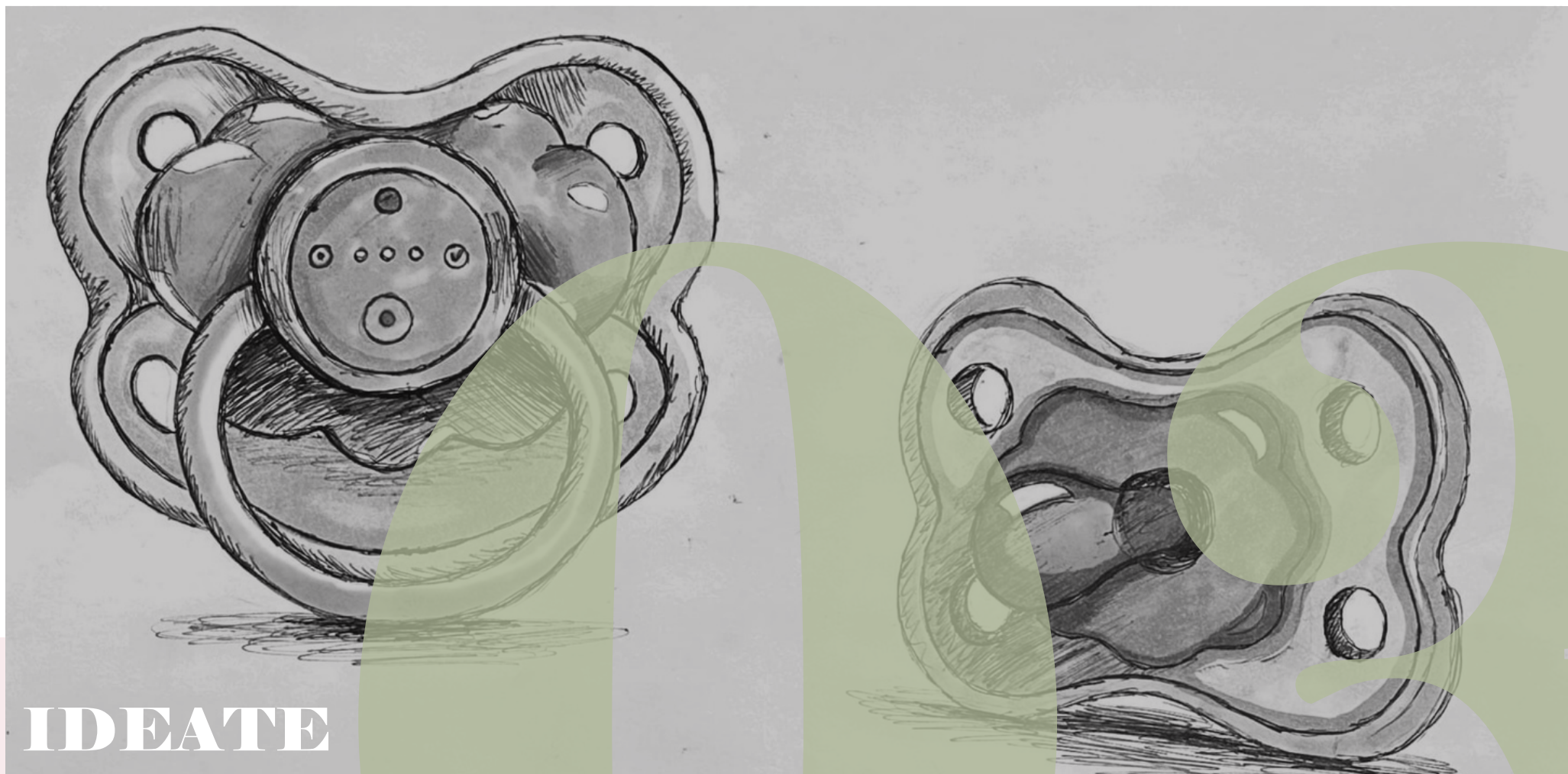
A caregiver responsible for infant wellbeing needs a solution that is non-invasive and intuitive because they are juggling multiple responsibilities and can't afford to misuse complex technology.



3

RELIEVING A&E OVERLOAD

An overstretched NHS paediatric team needs fewer non-urgent baby admissions because many cases could be managed at home with early monitoring and clearer parental guidance.



CONCEPT DEVELOPMENT & CREATIVE STRATEGY

This chapter captures the creative development process that followed a deep understanding of the problem space. With real user insights as the foundation, this phase involved generating imaginative, thoughtful ideas that could translate parental stress and NHS strain into meaningful design opportunities.

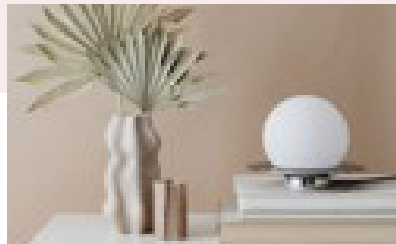
Through moodboards, mind mapping, and iterative sketching, a range of potential solutions were explored—each considering usability, comfort, and feasibility. The goal was not just to innovate, but to design responsibly: creating a product that feels intuitive to parents, adaptable to infant needs, and ultimately impactful for wider healthcare systems.

Designing Within Real-World Boundaries

1 **Balancing Innovation with Realism –**
Concepts needed to be both visionary and practically achievable within the healthcare context, limiting overly ambitious or tech-heavy ideas.

2 **Designing for Emotion & Function –**
Ideas had to address both emotional reassurance for parents and operational efficiency for the NHS, creating tension between softness and technicality.

Cleanliness
& Hygiene ↘



Biomorphic
Textures ↘



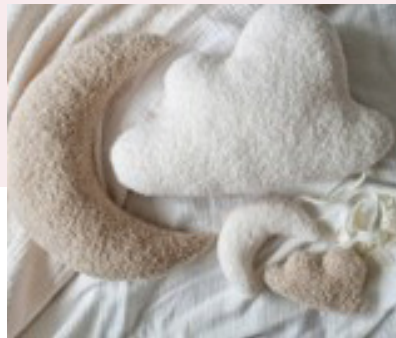
Softness
& Safety ↘



Infant Comfort
Objects ↘



Minimal UI
Inspiration ↘



Neutral,
Calming Tones ↗

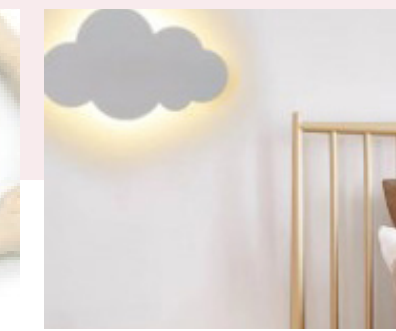
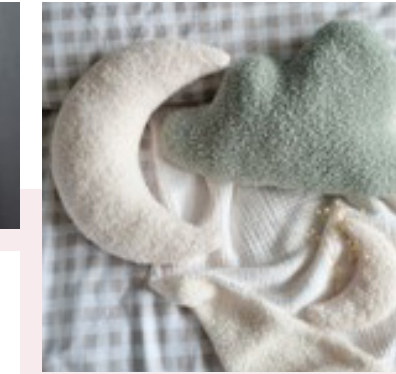
Natural Materials
Influence ↘



Sensory
Gentleness ↘



Parent-Friendly
Usability ↘



Subtle
Ambient Lighting ↗

MOODBOARD

INITIAL CONCEPTS

STEP 1

I started off with quickly sketching a wide variety of pacifier shapes inspired by nature, toys, animals, and playful objects—from clouds and sunflowers to bumblebees and game controllers.

This brainstorming phase helped me explore how visual identity could influence comfort, emotional response, and appeal to both parents and babies. While many ideas were imaginative and fun, I refined my direction by prioritising designs that felt soft, non-intimidating, and functionally realistic for a baby product. Concepts that were too detailed, bulky, or difficult to manufacture were filtered out, allowing me to focus on forms that balanced friendliness, feasibility, and familiarity—eventually leading to the cloud-inspired direction.

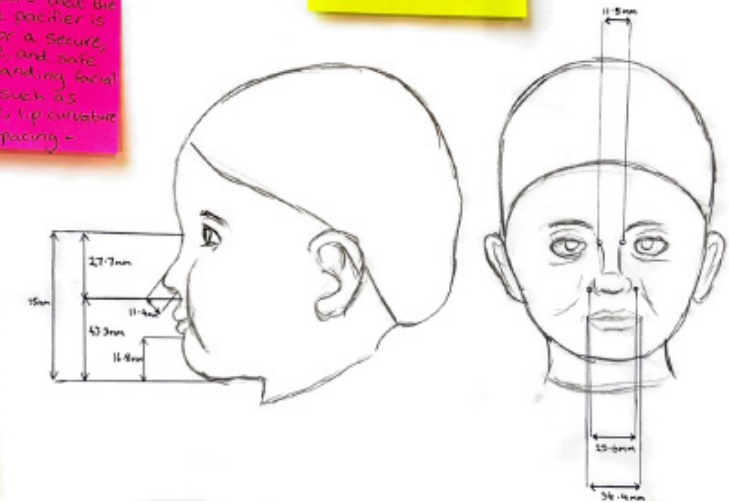
ANTROPOMETRIC DATA

I researched infant anthropometric data to understand safe proportions and ensure the design would comfortably and securely fit a baby's face without obstructing breathing.



NOTES:
I researched the anthropometric data of a child's face to ensure that the smart infant pacifier is designed for a secure, comfortable, and safe fit. Understanding facial dimensions, such as mouth, chin, lip curvature, and nasal spacing,

Anthropometric Data
[Diagram]



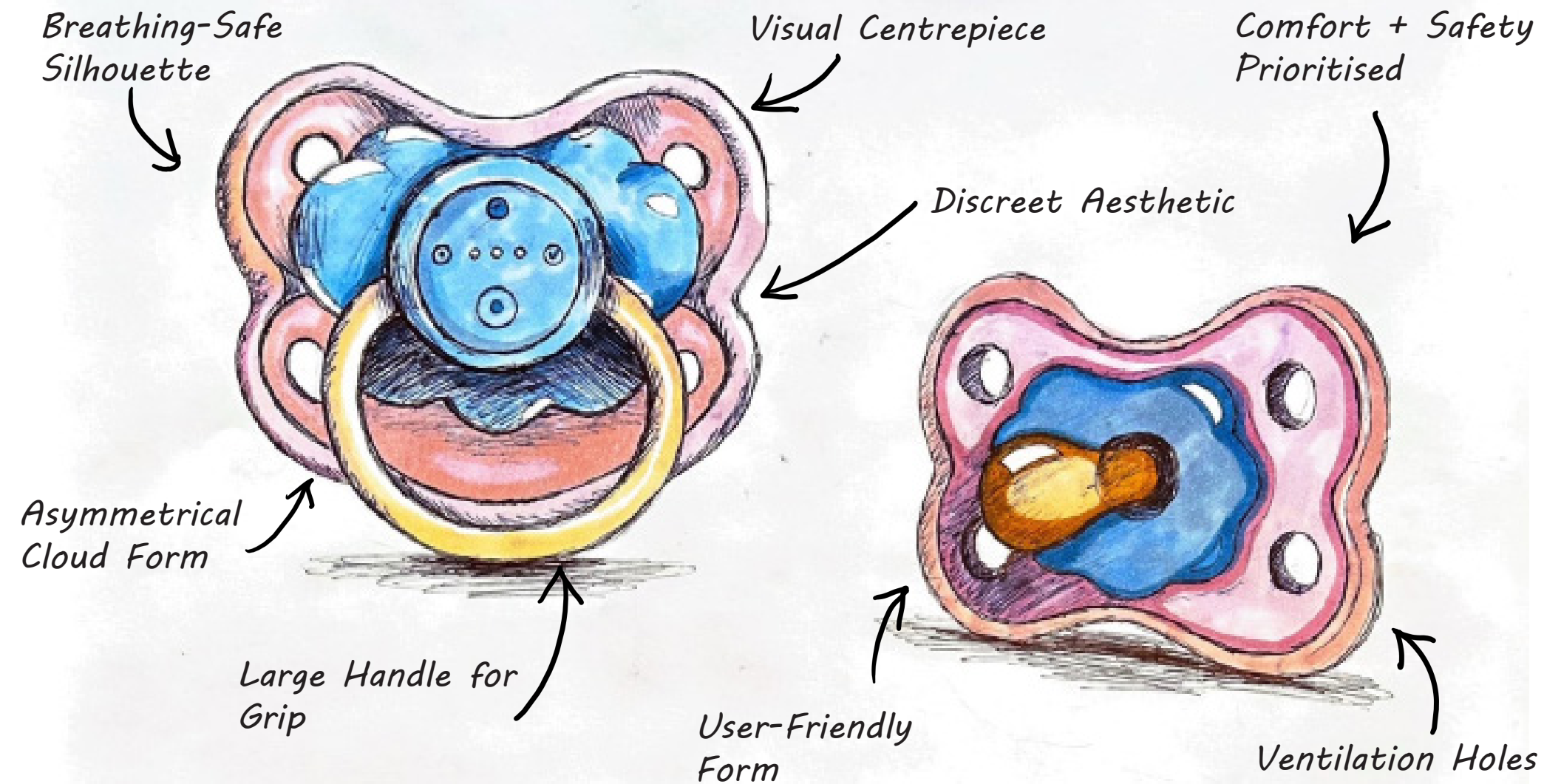
is essential for creating a pacifier that accommodates infants of different ages while avoiding discomfort or breathing obstructions. This data also helps in optimizing the pacifier's shape for effective sensor placement, ensuring accurate health monitoring without irritation.

STEP 2

This early concept explored a sleek, symmetrical cloud shape with a modern, playful aesthetic. However, after reviewing infant anthropometric data, I realised the raised 'hump' at the top could risk obstructing the baby's airway. This highlighted the importance of balancing aesthetics with anatomical safety. The perfect symmetry also felt too clinical and lacked the natural softness I was aiming for. Inspired by real clouds, I moved toward a more organic, asymmetrical shape, one that felt visually gentle, safer, and more ergonomic.

CHOSEN CONCEPT

TO BE REFINED...



USER-CENTRED DECISION

The final concept was directly shaped by consistent feedback across all interviews, especially from parents and carers, who stressed the importance of simplicity and emotional reassurance. Many expressed concerns around tech feeling “too complicated” or “invasive,” so the final design keeps smart functionality hidden within a soft, baby-friendly form, ensuring it feels familiar and safe.

CHILD SAFETY & COMFORT

By researching infant anthropometric data, I ensured the pacifier avoids any top-heavy or protruding features that could obstruct breathing or create discomfort. The silhouette is compact and curved to sit comfortably on a baby’s face, while also adhering to known ergonomic safety parameters for infant wearables.

DISCREET TECH INTEGRATION

Rather than making technology the visual focus, this design conceals the sensors and components within the pacifier’s form. This matches both the visual inspiration gathered from your moodboards and feedback from users who didn’t want devices that “look like tech.” It blends seamlessly into everyday baby products, avoiding visual alarm or confusion.

SOOTHING VISUAL IDENTITY

The organic, cloud-like form was retained and softened further because of its calming associations with comfort, sleep, and safety—elements deeply valued by both children and caregivers. Clouds also carry a delicate, gentle symbolism, which felt especially appropriate given the fragile nature of the sick infants who will be using this product. Unlike earlier symmetrical drafts, this final design introduces a more asymmetrical, natural shape—balancing friendliness with functional design cues.

Companion App with Parent Community

All vital data from the pacifier—such as signs and symptoms—would sync wirelessly via Bluetooth to a dedicated mobile app. This eliminates the need for screens on the pacifier itself. The app could also host a private group chat, offering parents a space to share advice, ask questions, and receive emotional support from others going through similar experiences.

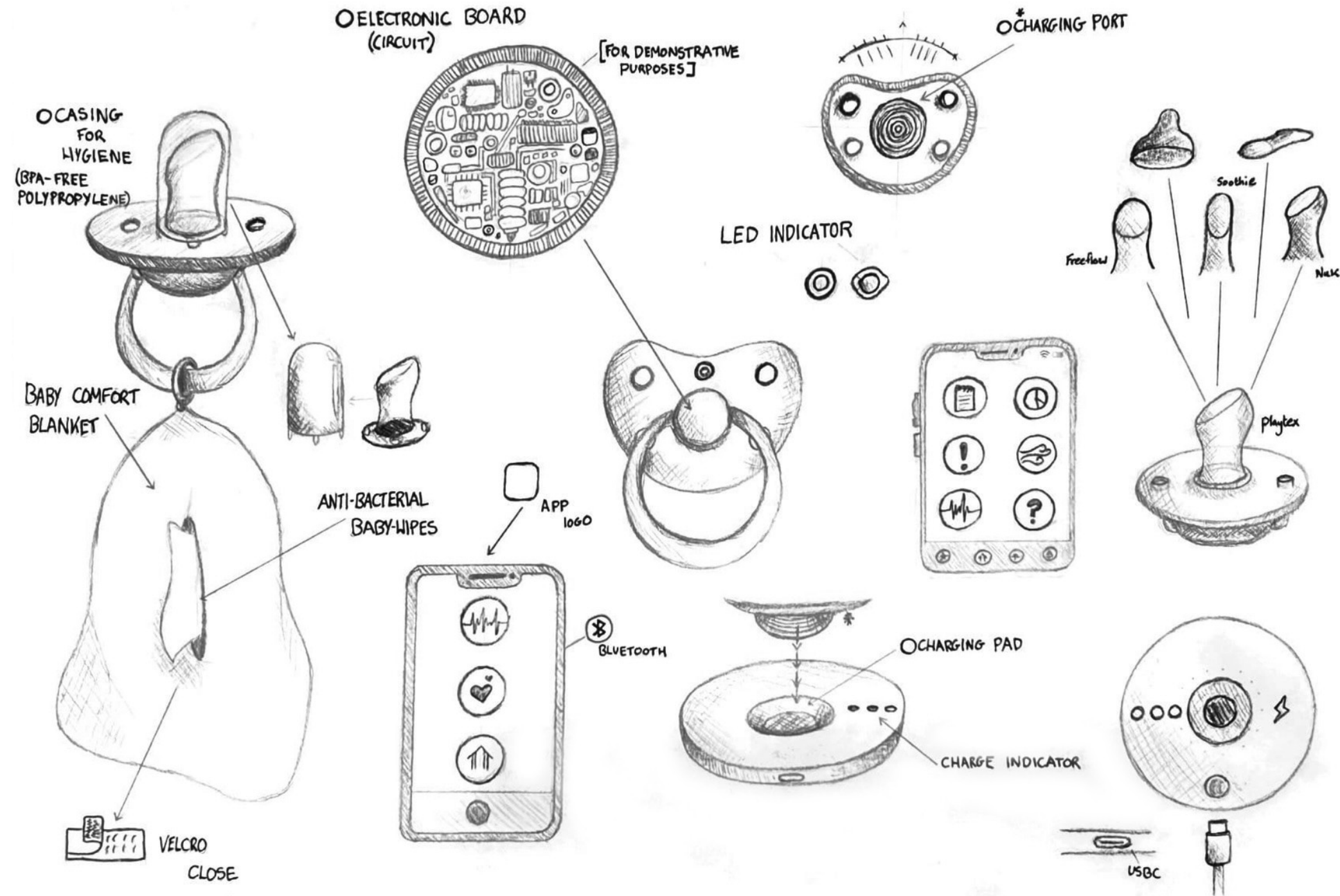
Dual Charging System with Compact Internal Tech

To ensure usability at all times, the pacifier could feature both a wireless charging pad for everyday convenience and a backup battery option—providing flexibility for parents, even in urgent situations.

Technologically, this is made feasible by the availability of compact, low-energy microchips and flexible printed circuit boards (FPCBs), which allow essential sensors and electronics to be embedded discreetly within the pacifier's core. These components are small enough to remain non-invasive, ensuring both safety and comfort for the infant.

Comfort Blanket Attachment with Hygiene Pouch

A soft, comforting blanket could attach to the pacifier to help soothe the baby while also improving grip, reducing the chances of it being dropped. The blanket would double as a hygiene aid, featuring a pouch for storing antibacterial baby wipes and a muslin-lined pocket to safely store the pacifier when not in use.





PROTOTYPE

FORM EXPLORATION

This chapter visualises the concept by translating insights into tangible, high-fidelity prototypes that communicate both form and function. While Ceila does not include working electronics, this phase focuses on accurate visual representation of how the product would appear and be used in real life.

The prototype aims to capture the comfort, discretion, and intuitiveness highlighted by users during earlier research—ensuring the pacifier looks and feels familiar while clearly conveying its smart functionality. Every design decision, from material selection to proportions and colour scheme, reflects real-world feedback and emotional responses gathered during testing and interviews. This stage allows stakeholders to engage with a realistic model, helping to validate the concept’s visual identity, usability, and desirability ahead of further refinement or development.

Prototyping Challenges

- 1 Communicating Function Without Functionality -**
One of the biggest challenges was creating a prototype that looked smart and capable—without any real technology inside. The design had to visually suggest intelligence and purpose, using only form, colour, and detail.
- 2 Designing for Babies, Not Just Parents -**
While the pacifier needed to meet parents’ expectations for safety and reassurance, it also had to suit the baby. Balancing technical-looking features with a soft, calming appearance was essential to avoid rejection during use.



MODELLING DEVELOPMENT

Exploring Form, Function & Feasibility

To bring my concept to life, I explored a range of materials to quickly communicate ideas in three dimensions. Each model served a unique purpose—whether visualising scale, testing form, or understanding the relationship between components.

Each prototype stage enabled me to test a different aspect of the design. Beyond form and scale, I began considering weight distribution, mouth placement, and how the pacifier would sit against the baby's face. Creating these variations helped evaluate comfort, symmetry, and overall usability from both a user and manufacturing perspective. This iterative approach ensured that the product was not only visually appealing but practical, ergonomic, and ready for further refinement.





DISCOVERIES
The cardboard version helped establish basic form and dimensions, while foam gave insight into tactile quality and comfort. The clay model allowed a more detailed visualisation of surface and contours. Finally, the first 3D printed prototype tested scale and assembly, revealing minor sizing issues and design refinements for future



MODELLING CONTINUED...



IMPACT
This multi-material process was essential for refining the design. It allowed me to physically engage with the shape, identify design flaws early, and prepare for digital prototyping. These hands-on explorations grounded the concept in reality and guided further decisions on manufacturing and user interaction.

- Proportional scalingiterations
- Organic form
- Facial fit
- Material contrast
- Grip placement
- Symmetry rejection
- Component bulk
- Flat-back comfort
- Tactile testing
- Functional clarity
- Visual softness
- Tech concealment
- Form refinement
- Hygienic contour
- User-friendly

KEY INSIGHTS

Clay Prototyping

Ergonomic Mouth Fit – Sculpting with clay helped evaluate how comfortably the pacifier sits around the infant's mouth contour without excessive overhang.iterations.

Depth Awareness – Manually modelling revealed the exact limit for safe and comfortable teat depth, helping avoid any choking risks It confirmed how important it is to have a it permantly fixed during manufacturing..

Angle of Teat Tilt – Exploring different tilt angles helped determine the most natural orientation for the teat, ensuring it aligns comfortably with the baby's mouth. This process also supported decisions around the correct size and shape of the teat.



Cylindrical Tech Chamber – The raised round centrepiece was refined to function as a sealed capsule. A removable lid was planned only for assembly—allowing the internal sensor board to be inserted before the part is permanently sealed, preventing tampering or choking hazards.

Child Safety Prioritised – This internal sealing strategy directly addresses safety concerns—by eliminating removable parts after manufacturing, the risk of loose components is reduced to nearly zero.

Unified Body Structure – Through prototyping, I decided the entire faceplate of the pacifier should be a single moulded unit. This reduces the number of seams or joins on the front, improving safety and making the product easier to sterilise.

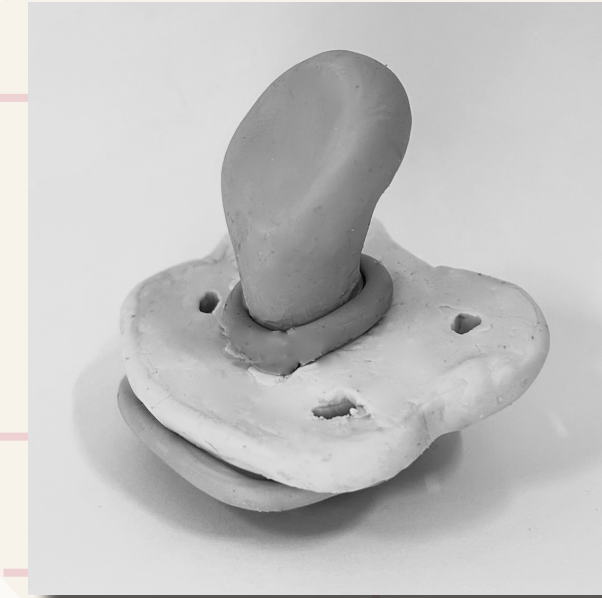
Separate Handle & Teat – The handle and teat will be kept as separate components to allow for appropriate material selection (e.g., medical-grade silicone for the teat), while simplifying replacement or upgrades in future versions.

Refined Handle Thickness – Sculpting by hand highlighted the need for a slightly thicker handle for better grip. Will also be non-detachable after manufacturing.

Realistic Form-to-Function Proportions – The clay helped define a balanced centrepiece that's large enough for tech but small enough to be safe and comfortable.

Visibility of Indicators – It became clear which positions were most visible for subtle LED indicators, avoiding awkward placements that would be blocked by baby's lips or cheeks.

User-friendly Curves – Soft edges were easier to assess tactilely through clay, confirming that sharp or overly angular features should be avoided.

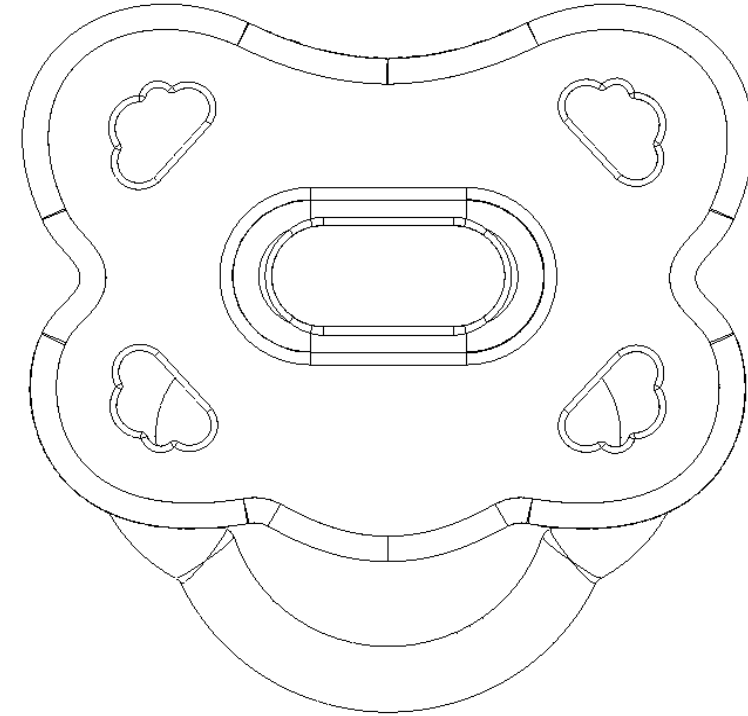
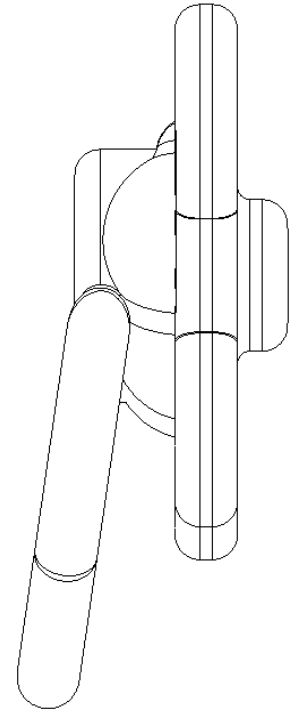
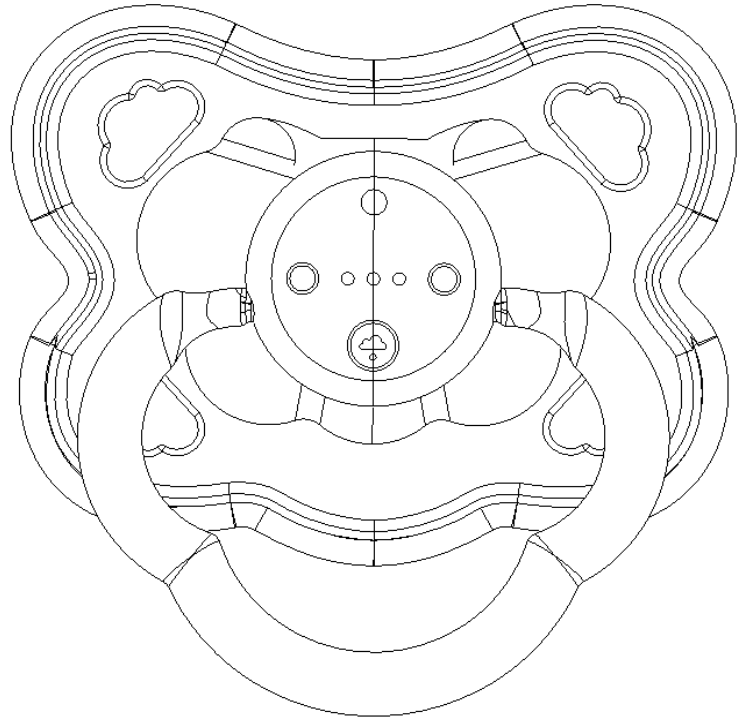


Understanding of Real Scale – Physical modelling helped solidify realistic overall dimensions, preventing scale distortion that can happen in 2D sketches.

Surface Texture Consideration – Handling the clay highlighted how matte vs. glossy areas might feel, helping plan material finishes for different regions (e.g., soft-touch front, smooth back).

Manufacturing Efficiency – A single-body outer shell means easier 3D printing/ injection moulding and less post-processing. It also makes water resistance more feasible and reduces long-term production costs.

CAD DEVELOPMENT

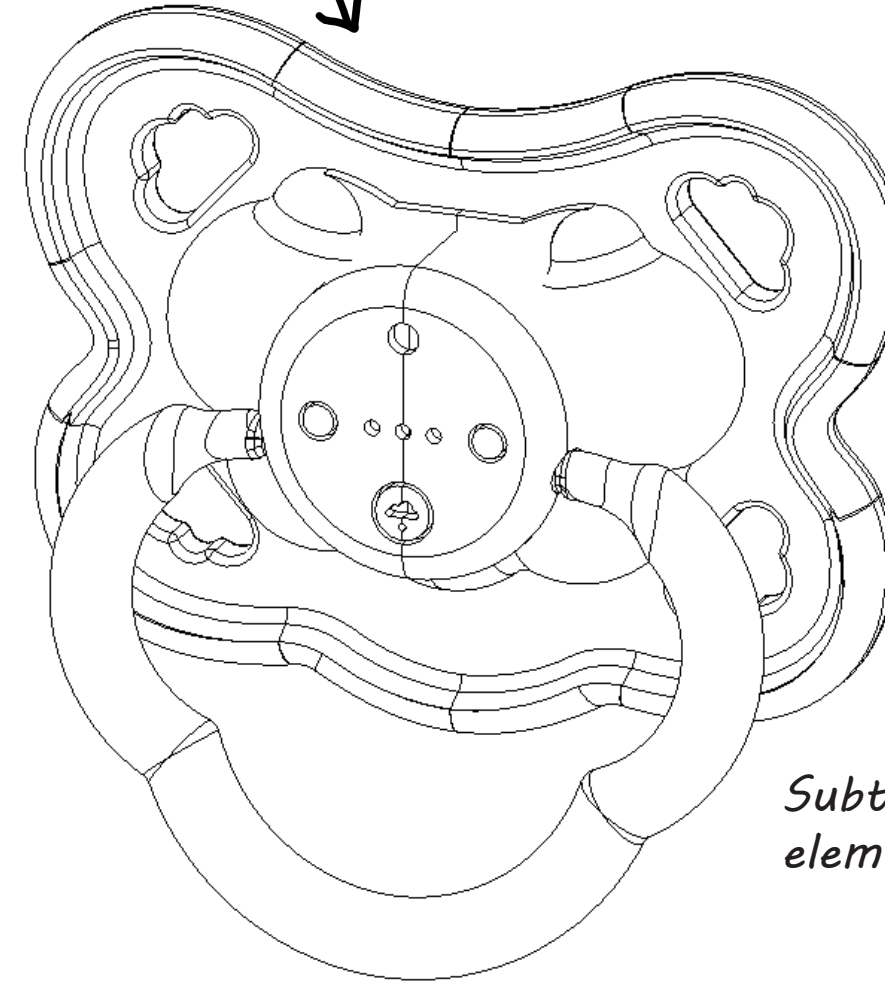


Digital Translation & Refinement -
This stage translated refined concepts into precise digital models, allowing for accurate scaling, internal component planning, and preparation for 3D proto-

Ventilation Design -
Side holes are positioned for breathability and skin comfort, preventing

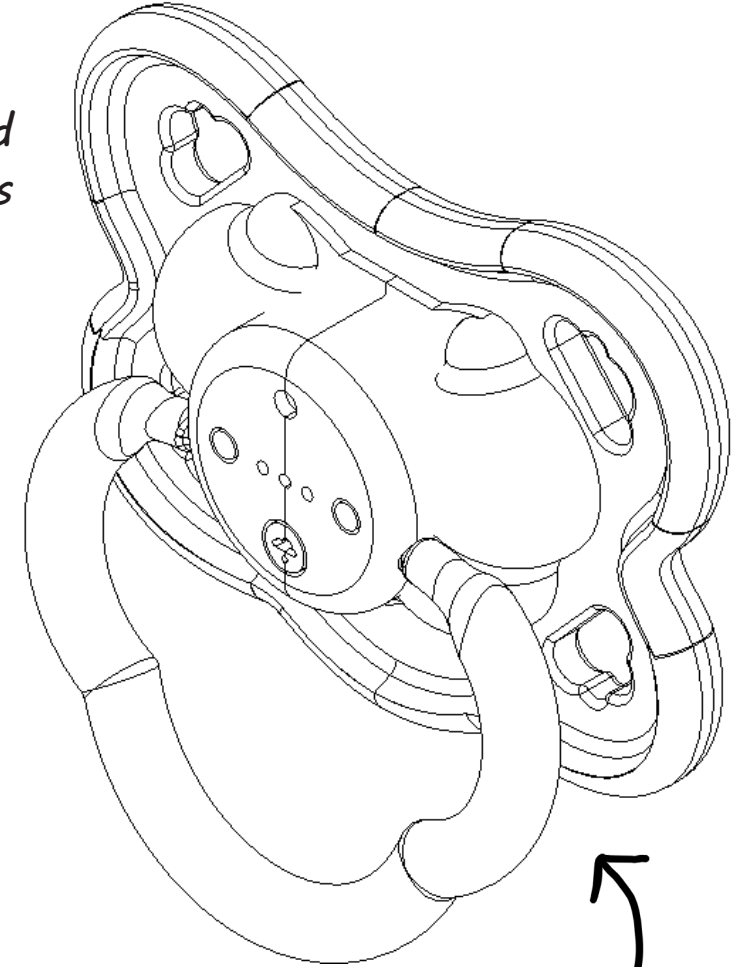
Front-Facing Functionality -
The symmetrical design ensures even pressure distribution and aligns naturally with an infant's face whilst keeping it aesthetically pleasing.

Cohesive Cloud Features



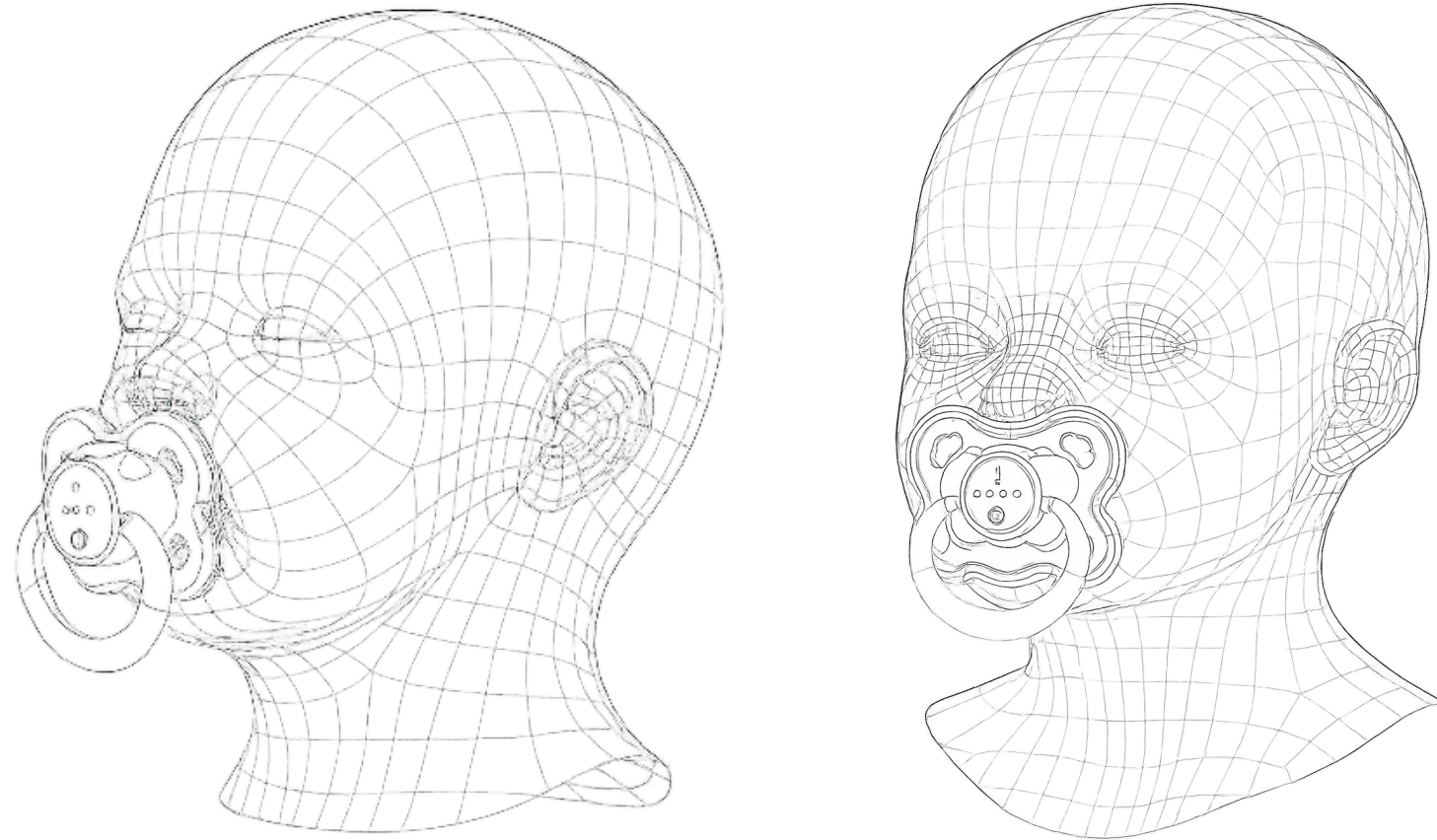
Smooth, Curved Edges

Subtle interface elements



Handle Manufactured seperately

Infant Fit VISUALISATION



Ergonomic Alignment & Fit -

One of the key challenges encountered during the CAD modelling process was aligning the pacifier's faceplate ergonomically against the baby's facial geometry. Early versions revealed slight misalignments that would have created discomfort or pressure points against the infant's nose and cheeks. By importing and referencing accurate anthropometric data of a baby's head and mouth, I was able to refine the curvature and dimensions of the pacifier base to ensure a soft, flush fit that doesn't obstruct breathing or movement.

Internal Housing & Safety Integration -

Another technical hurdle involved designing the internal compartment to house electronic components while maintaining a compact, tamper-proof exterior. The wireframe visualisation helped identify where the thickness of the shell could be subtly increased without compromising the overall form. Careful consideration went into the parting lines—opting for a sealed back enclosure with access only during manufacturing—to ensure no loose parts or openings that could pose a choking hazard.





TESTING & USER FEEDBACK

This chapter documents the evaluation phase, where early concepts were brought into real-world contexts to gather meaningful feedback from potential users. Testing focused on understanding how well the prototypes met the emotional and functional needs identified earlier in the process.

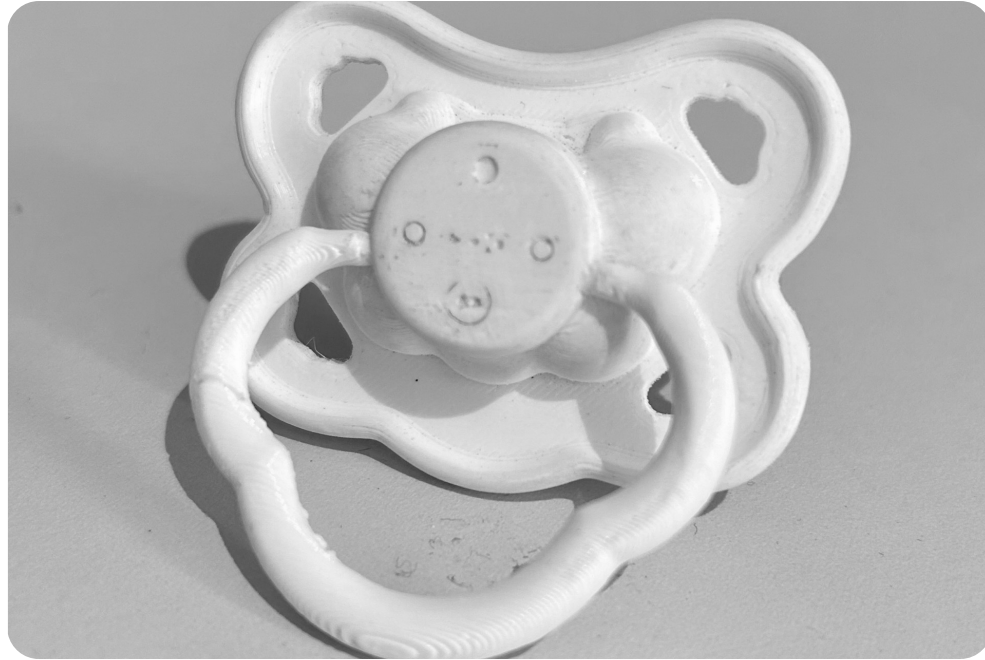
By observing interactions and collecting honest reflections from parents and carers, the design was refined to improve usability, comfort, and clarity. Special focus was placed on how intuitive the pacifier felt, how much trust it inspired, and whether it alleviated anxiety in practical situations. This phase was crucial in bridging the gap between design intent and real-life impact, guiding the final iterations based on actual experiences.

Testing Constraints

1 Prototype Testing Safety-
Time limitations and access to real infant users posed a challenge during prototype testing. Much of the feedback had to rely on secondary users (e.g., parents or carers) and simulated use, which limited direct data on infant interaction.

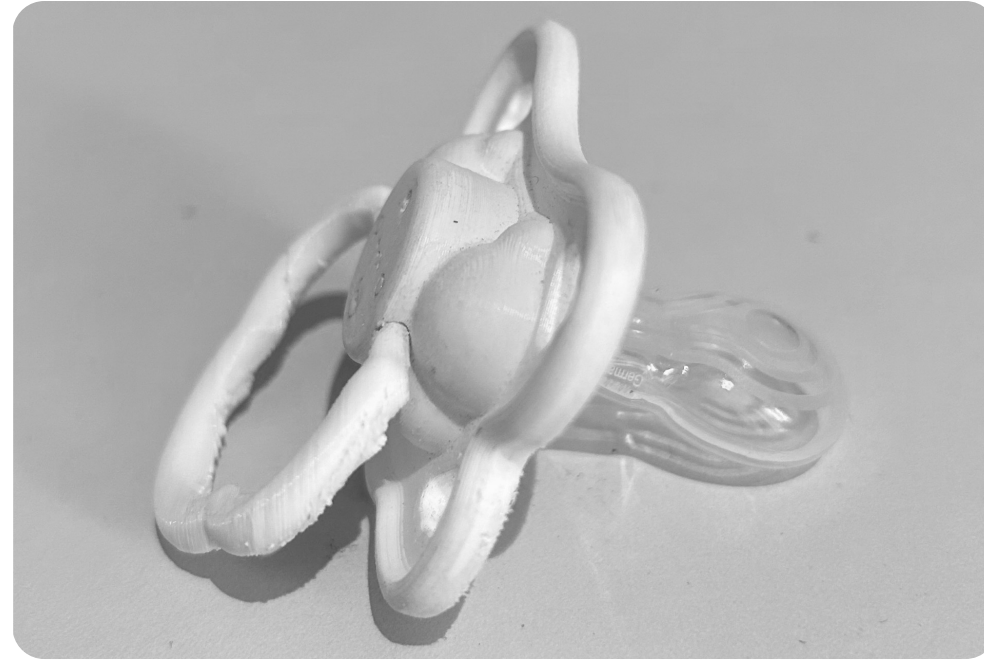
2 Low-Fidelity Limitations -
As the prototype was non-functional, testing focused on physical form and usability rather than technology. A basic prototype app was developed to simulate interaction and gather insight into parental preferences, but without real data connectivity, the emotional impact and practicality were harder to evaluate.

3D PRINT



3D Print - Initial Prototype

The initial prototype was printed using a Prusa i3 MK3S+ with PLA filament. The 3D print successfully captured the overall shape and structure of the pacifier, allowing me to assess the form, handle design, and shield proportions physically. Using PLA made it easy to quickly produce a visual model; however, fine surface details were slightly rough, therefore needed to be sanded down to get rid of any sharp edges/ imperfections.



Prototype Issues - Nipple Attachment

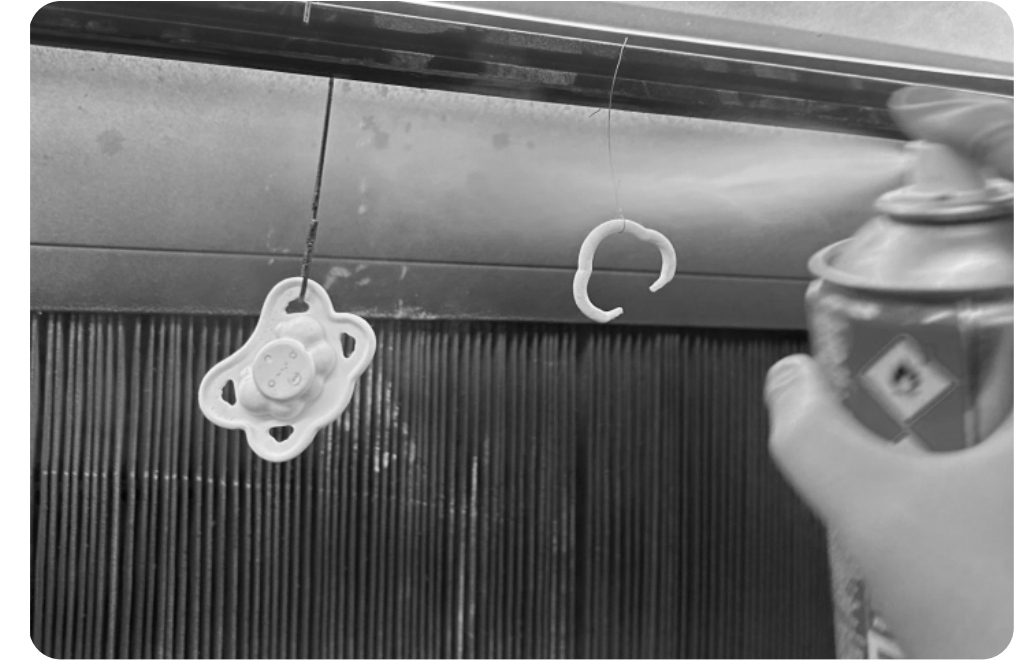
During testing, attaching the nipple to the 3D printed prototype was purely for visual purposes. Due to the rigidity of the PLA material, the teat could not be securely fixed into place as it would be in the final product. In real-world manufacturing, the design will ensure that the teat is securely clipped and sealed into the pacifier body, eliminating any movement and preventing potential safety hazards.

PROTOTYPE ISSUES



3D Print - Assembly Testing

After printing, I attempted to fit the different parts together, especially the PLA printed body and a standard silicone nipple. A key challenge was the inflexibility of PLA — unlike medical-grade silicone or TPE, PLA is rigid, making it difficult to test assembly and realistic fit. The printed parts were useful for visual and ergonomic checks but unsuitable for fully simulating functional stresses like pulling or chewing. Moving forward, I will consider printing with flexible filaments such as TPU.



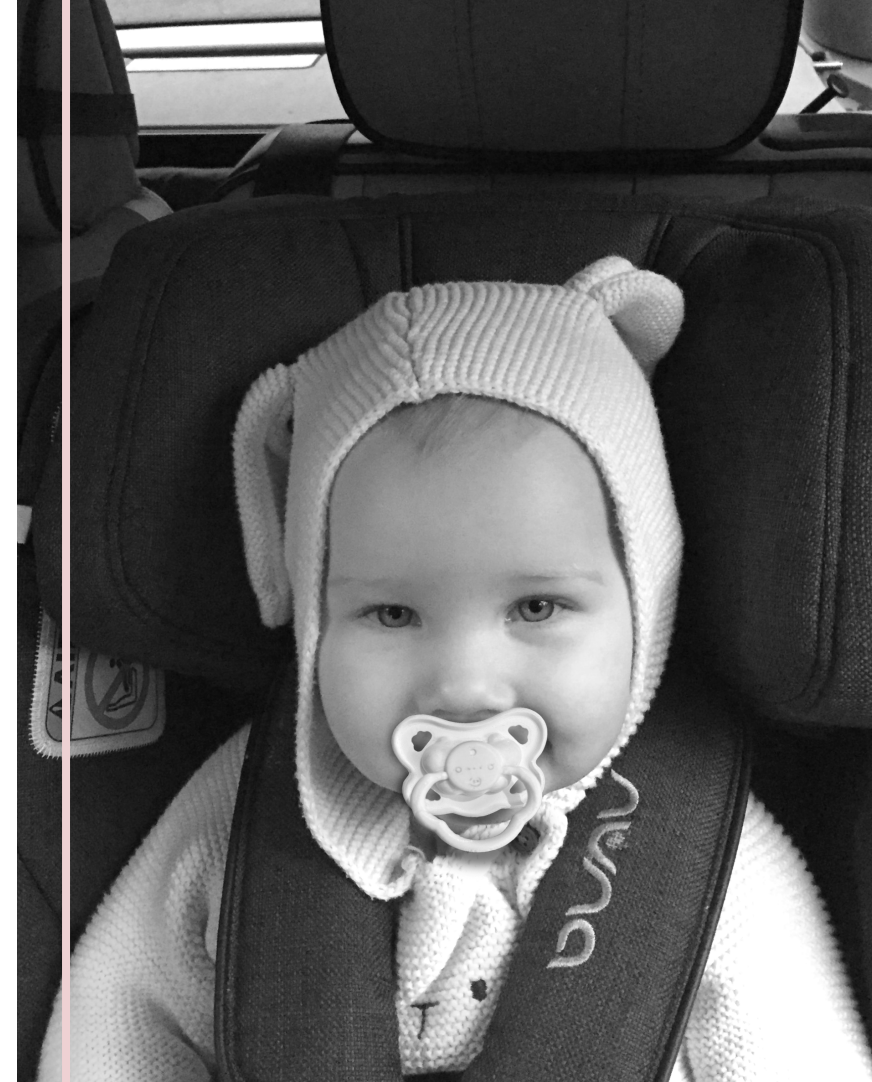
Prototype Finishing Process

After 3D printing the pacifier model using PLA, I refined the surface by sanding it with a range of sandpaper grits, starting with coarse paper to remove major print lines and progressing to finer grits for a smoother finish. Once the surface was prepared, I applied a spray primer to create an even base coat, followed by carefully painting the model to match the intended final appearance. Additional details were added by hand to enhance realism. Finally, I assembled the parts, including attaching the visual representation of the teat.

VISUAL TESTING

Reasoning Behind Method-

To safely visualise the concept in use, I chose to digitally edit images of my 3D-printed prototype onto photographs of my baby sister. This approach allowed me to assess the scale, fit, and visual impact of the pacifier without the risks associated with testing an unfinished, unapproved prototype on a real infant. It provided a safe, effective way to gather early insights into how the design would interact with facial features and positioning.



Key Observations-

The visual testing confirmed the pacifier's proportions felt appropriate for an infant's face, with no large or intrusive features obstructing the nose or mouth area. It also highlighted opportunities to refine the handle's scale to maintain comfort, ensure a lightweight feel, and further minimise any potential facial obstruction during use. This method of simulated testing enabled refinement of ergonomic details and proportions before progressing to more advanced, safety-certified prototypes.



ETHICS & SUSTAINABILITY

CONSCIOUS INNOVATION

This chapter reflects on the ethical and environmental responsibilities considered throughout the development of Ceila. From early concept stages to prototype refinement, decisions were guided by a commitment to create a product that is safe, inclusive, and sustainable.

The design responds to healthcare pressures without adding unnecessary complexity, waste, or risk. It considers parental trust, infant safety, and long-term NHS impact—balancing material choices, usage behaviour, and future disposal. Alongside technical and emotional needs, issues like data privacy, accessibility, and circular design were explored to ensure the product is responsible across its full lifecycle.

This phase reinforces that meaningful innovation doesn't end at usability—it must also consider its wider social and environmental footprint.

Responsible Design Challenges

1 **Material Responsibility vs. Safety** – Finding sustainable materials suitable for infant use was challenging, as many lacked the required hygiene or durability standards for healthcare.

2 **Ethics in a Simulated Context** – With no working tech, ethical considerations like data handling and user trust had to be addressed hypothetically rather than through real-world testing.

Data Protection
(GDPR)



Sensitive health data demands strict GDPR compliance, secure encryption, and parental consent protocols.

Equity in Access



Affordability aims to close healthcare gaps and provide affordable design for all socioeconomic groups.

Inclusivity



Designed to accommodate a wide range of infant users with different needs and preferences.

Sustainable Materials



Material selection focused on sustainability to minimise waste and environmental harm.

KEY ETHICAL ISSUES

Overall Ethical Responsibility

Throughout the project, ethical responsibility was embedded into every design decision. By considering user privacy, accessibility, and environmental impact together, the Ceila pacifier reflects a broader commitment to social good.

Designing for real-world practicality while protecting vulnerable users ensures that the product remains trustworthy, safe, and aligned with wider healthcare and sustainability goals.

LEGISLATION & CODES

Objective

Compliance with legislation and codes of practice is essential for ethical and sustainable product design. These frameworks protect public health and the environment and build trust in innovations like the smart pacifier. Following these principles ensures safety and sustainability, crucial for user trust and regulatory approval.

Legal Frameworks	Sustainability Standards	NHS Guidelines
 The General Data Protection Regulation (GDPR) outlines the ethical management of sensitive user data, especially regarding apps or cloud storage associated with pacifiers. This regulation ensures parental consent protocols, data encryption, and secure processing of any information collected. Complying with the GDPR protects user privacy and helps prevent data breaches.	 • ISO 14001: Ensures environmental sustainability in manufacturing processes. • ISO 13485: Guarantees quality management for medical devices. By adhering to these guidelines, the pacifier design effectively lowers its carbon footprint and aligns with global sustainability objectives.	 The NHS's net-zero carbon targets guide the development of environmentally friendly healthcare products, emphasising recyclable materials and energy-efficient processes. Aligning with these goals ensures the product supports healthcare objectives while meeting regulatory standards.

MATERIAL CHALLENGES

- 1

BPA-Free and Non-Toxic – Materials must be safe for infant contact and oral use.
- 2

Durable Under Stress – Must resist tearing, cracking, or deforming with frequent use.
- 3

Sterilisation Resistant – Able to withstand heat, moisture, and cleaning chemicals without degradation.
- 4

Softness and Flexibility – The teat and surrounding areas must be soft enough for safe sucking but durable enough to not split or tear.
- 5

Recyclable or Biodegradable Options – Wherever possible, materials must offer a sustainable end-of-life pathway.
- 6

Secure Bonding Compatibility – Materials must allow secure bonding/sealing to prevent parts from detaching (important for the one-piece body concept).

Medical-Grade Silicone	PLA Bioplastic	TPE (Thermoplastic Elastomer)	PVC (Polyvinyl Chloride)	ABS Plastic
✓	✓	✓		✓
✓		✓	✓	✓
✓		✓		✓
✓		✓		
	✓			
✓	✓	✓		✓

SUSTAINABLE DESIGN CHOICES

Material Selection – Balancing Pros and Cons

Choosing materials for Ceila required balancing safety, sustainability, durability, and manufacturability. Medical-grade silicone offered major advantages: it is hypoallergenic, BPA-free, soft enough for oral use, is safe for embedding tech, highly durable under sterilisation, and safe for prolonged infant contac. However, while silicone is technically recyclable, it typically requires specialist recycling streams and is not widely processed through standard household recycling. TPE was considered for additional parts due to its flexibility and recyclability potential, but concerns over long-term durability and chemical resistance in infant products made silicone the more reliable and safer option.

Final Decision – Prioritising Safety and Future Responsibility

Ultimately, medical-grade silicone was selected for both the nipple and the shield body due to its superior performance in areas critical to the product’s function, hygiene, and user trust. While recognising the material’s limited household recyclability, the design strategy incorporates the possibility of a manufacturer-led take-back programme to responsibly manage end-of-life products. Additional sustainable strategies, such as minimising material waste in production and designing for product durability, were also implemented to offset the limitations around end-of-life recyclability. By focusing on immediate infant wellbeing and long-term environmental responsibility, Ceila delivers a product that is both ethically responsible and practically effective for real-world healthcare needs.



LIFECYCLE DESIGN THINKING

Every design decision for Ceila considered the full product lifecycle — from material sourcing to end-of-life disposal. Prioritising durability, minimal waste, and responsible material choices ensures that the product not only supports infant wellbeing but also reduces its environmental footprint over time.

1

MATERIALS SELECTION:
Durable, non-toxic materials extend the pacifier's lifespan and reduce waste.

2

MANUFACTURING:
Partnering with local suppliers reduces transportation emissions while using renewable energy during production.

3

PACKAGING AND TRANSPORT:
Compact, lightweight packaging lowers shipping emissions. Biodegradable materials ensure easy disposal.

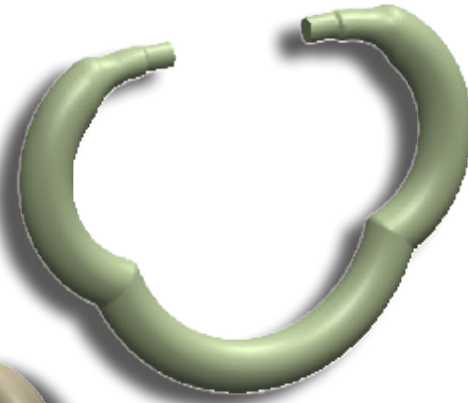
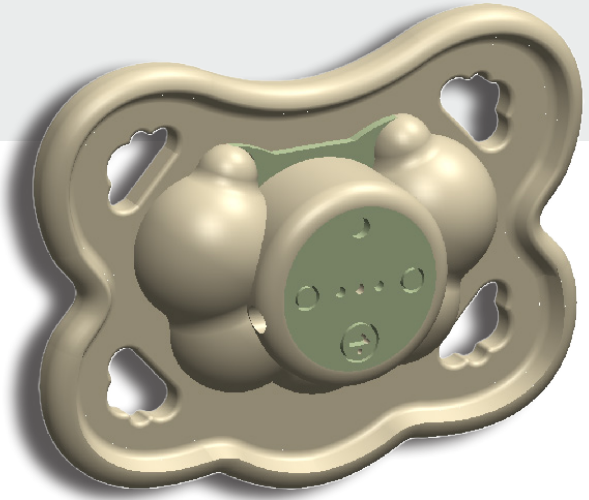
4

USE AND MAINTENANCE:
Long-lasting batteries and washable components ensure reusability and hygiene.

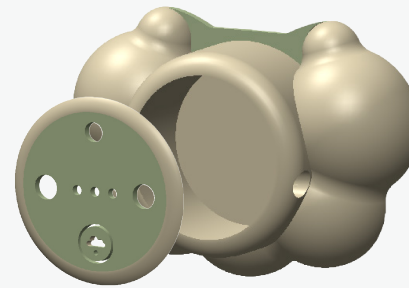
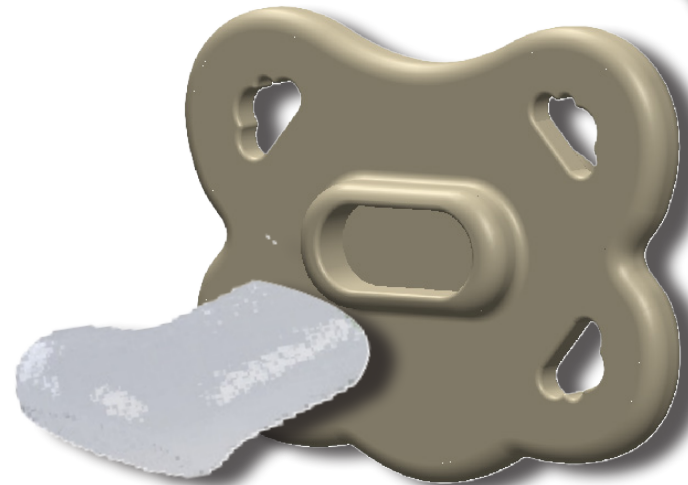
5

END-OF-LIFE:
A take-back programme allows users to return used pacifiers for recycling, reducing landfill waste.

DESIGN FOR ASSEMBLY & DISASSEMBLY



This product has been carefully designed with minimal, essential parts to support straightforward assembly and disassembly. The pacifier body, handle, and nipple are all separate components that slot securely into place, ensuring fast manufacturing while maintaining a strong, tamper-proof construction.



The detachable design also considers end-of-life recycling and potential repairability, reducing material waste and enabling easier breakdown of mixed materials.

Critical joins are engineered to be permanently sealed after assembly, protecting the internal technology and eliminating choking hazards, without compromising on future disassembly for recycling or responsible disposal.

COSTS

The hypothetical manufacturing process and associated costs if the pacifier were produced in the UK, ensuring high-quality, medical-grade materials while balancing affordability, sustainability, and safety standards.

Pricing and Scaling Notes:

RRP (Recommended Retail Price): Would likely need to be around **£39.99–£49.99** to cover costs and generate profit.

Break-even Point:

Would need to sell around **1500–2000 units** at **£40** each to recover setup/tooling costs.

Higher Volume Production:

At 10,000+ units, cost per unit could drop to **£7.50–£8.00**.



Realistic Early Production Cost:

£12.65 per unit

FUTURE IMPROVEMENTS

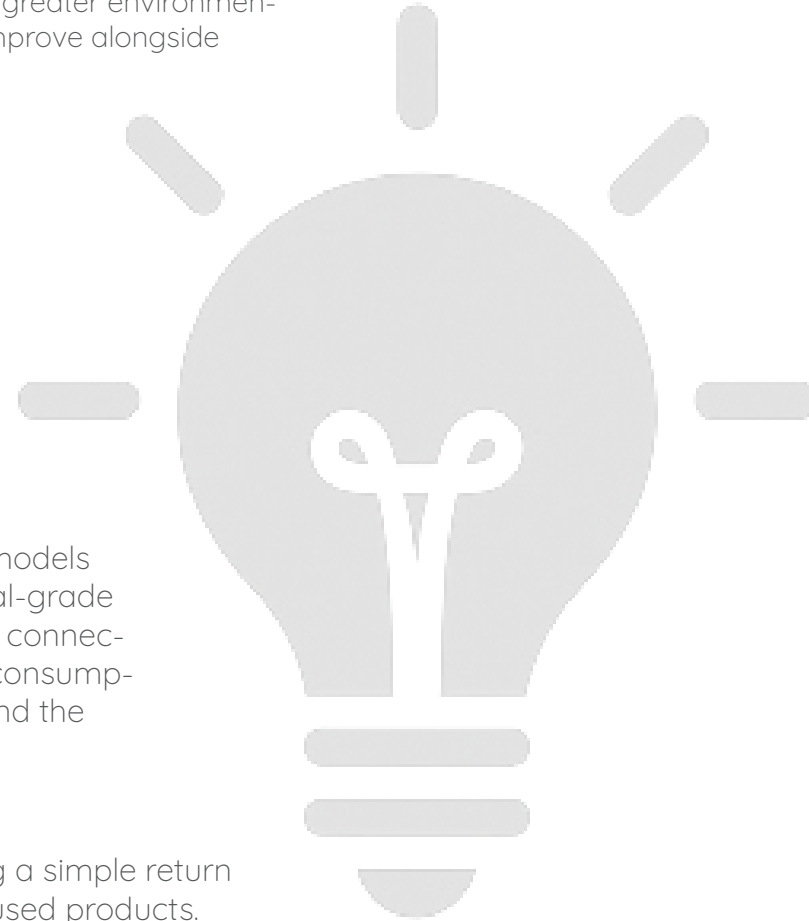
While this project prioritised sustainability at every stage, there is always room to evolve. Below are future opportunities for even greater environmental responsibility ensuring the product can adapt and improve alongside advancing sustainable technologies.

Bioplastics and Energy Optimisation

Exploring emerging bioplastics could allow future models to be fully biodegradable while maintaining medical-grade safety standards. Additionally, optimising the app's connectivity and background activity can reduce energy consumption, extending the battery life of both the device and the connected phone.

Collaborative Recycling Initiatives

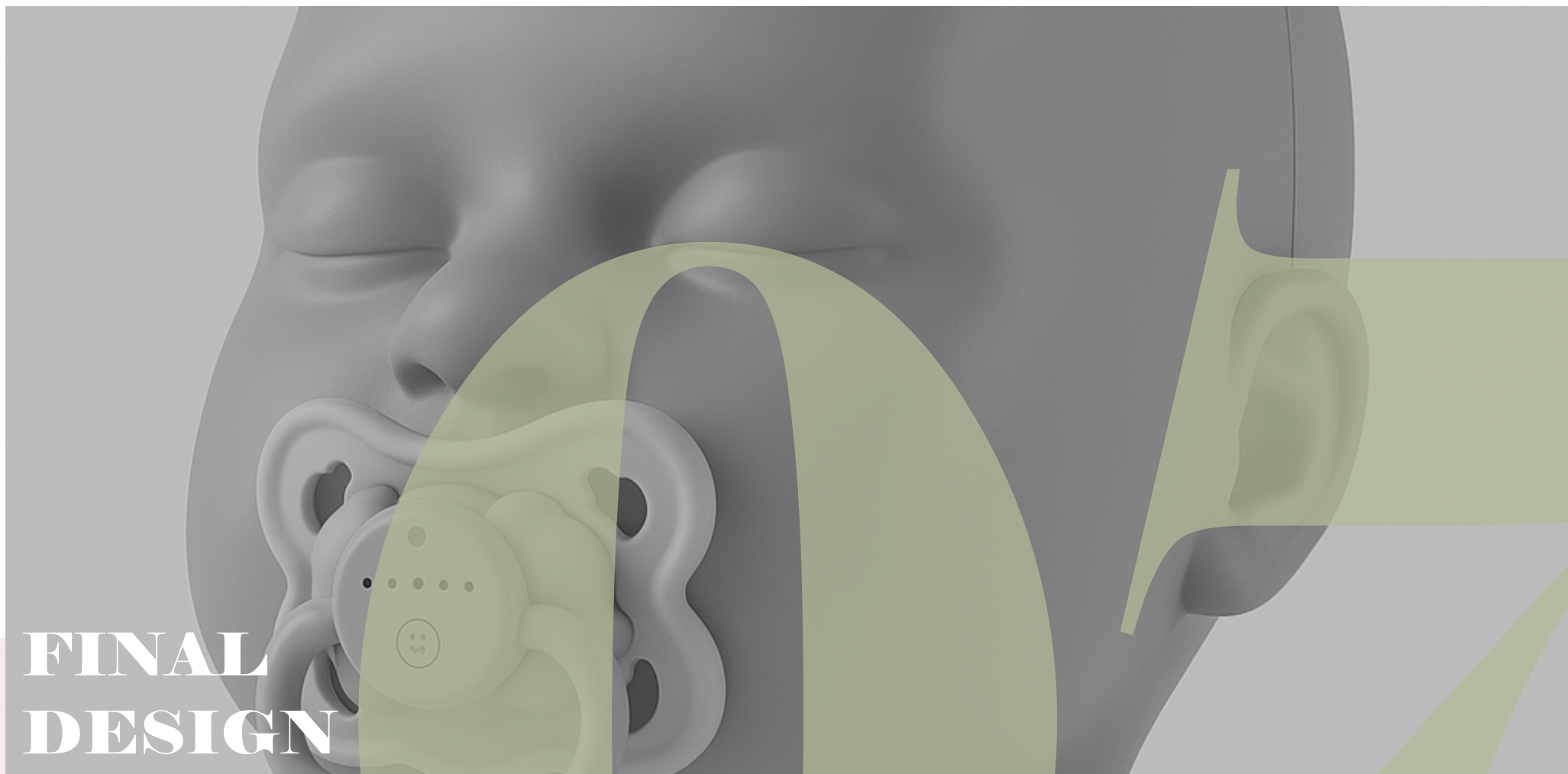
Partnering with NHS green initiatives and launching a simple return scheme would encourage responsible disposal of used products. Incentivising recycling through discounts or rewards could close the product loop, supporting NHS sustainability goals and promoting a more circular system for healthcare devices.



Driving Broader Healthcare Impact

While the immediate focus of this design is to support individual infant health and parental reassurance, the broader goal is to contribute to a future where early intervention technologies ease NHS strain and improve public health outcomes. By promoting proactive monitoring and reducing preventable hospital visits, innovations like this pacifier align with larger healthcare sustainability strategies — not just through materials and manufacturing, but by supporting system-wide efficiency and care equity.





**FINAL
DESIGN**

PRODUCT OUTCOME & DESIGN IMPLEMENTATION

This chapter presents the final outcome of the design process—a considered, user-informed product that responds directly to the emotional, practical, and systemic needs uncovered through earlier stages. Ceila represents the culmination of research, iteration, testing, and ethical reflection.

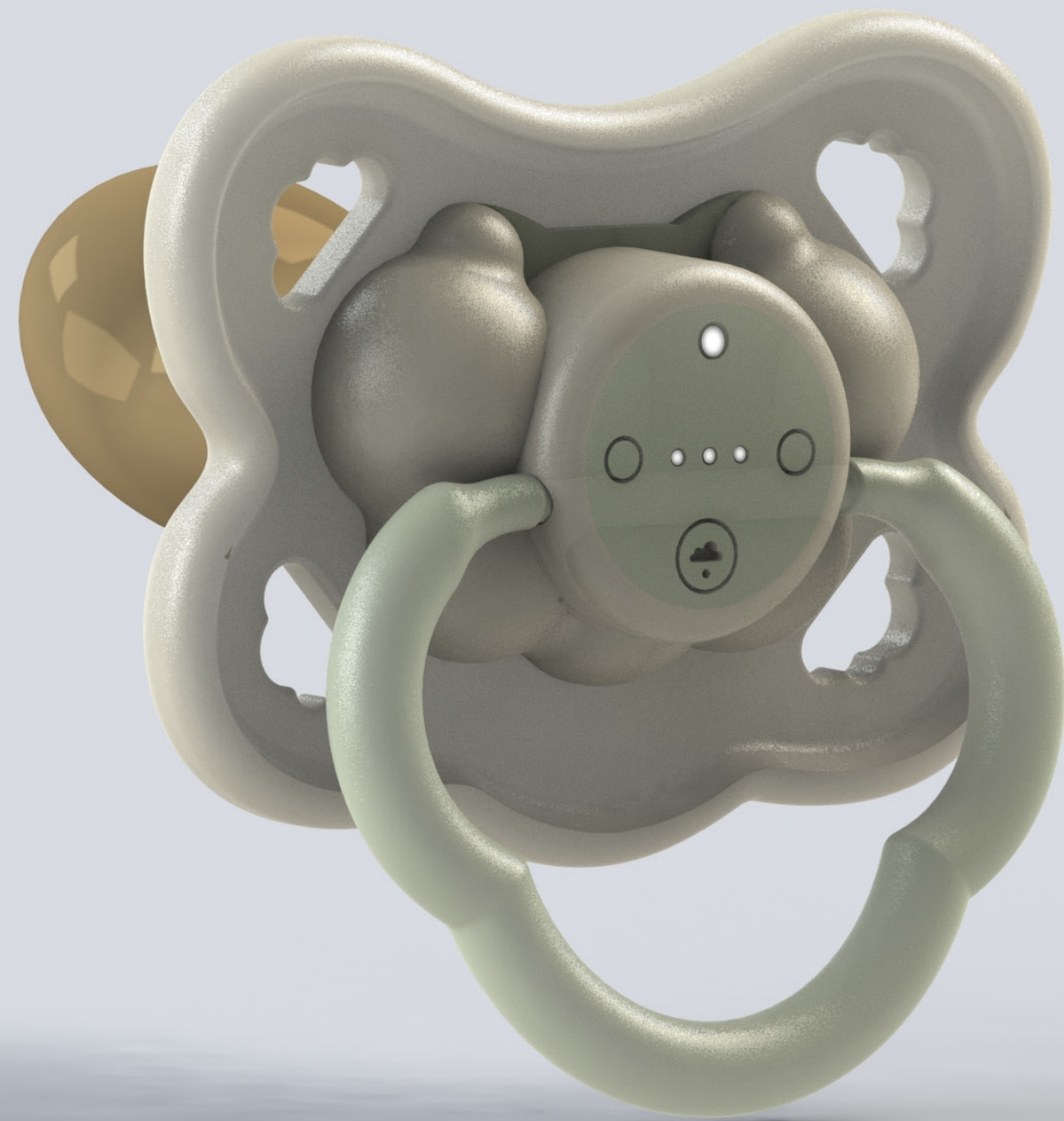
The final design balances a soft, baby-friendly form with subtle visual cues that suggest smart functionality. Every detail—from its proportions and colour palette to its interface and packaging—was chosen to reinforce trust, clarity, and comfort. Ceila is not just a pacifier; it's a gentle intervention with the potential to ease daily stress for families while supporting wider NHS efficiency. This outcome reflects a solution that is not only feasible but emotionally and socially relevant.

Final Refinement Barriers

1 Visualising Intelligence Without Functionality – Creating a non-working prototype that still conveyed smart capability required careful design cues—ensuring users understood its purpose without relying on digital interaction.

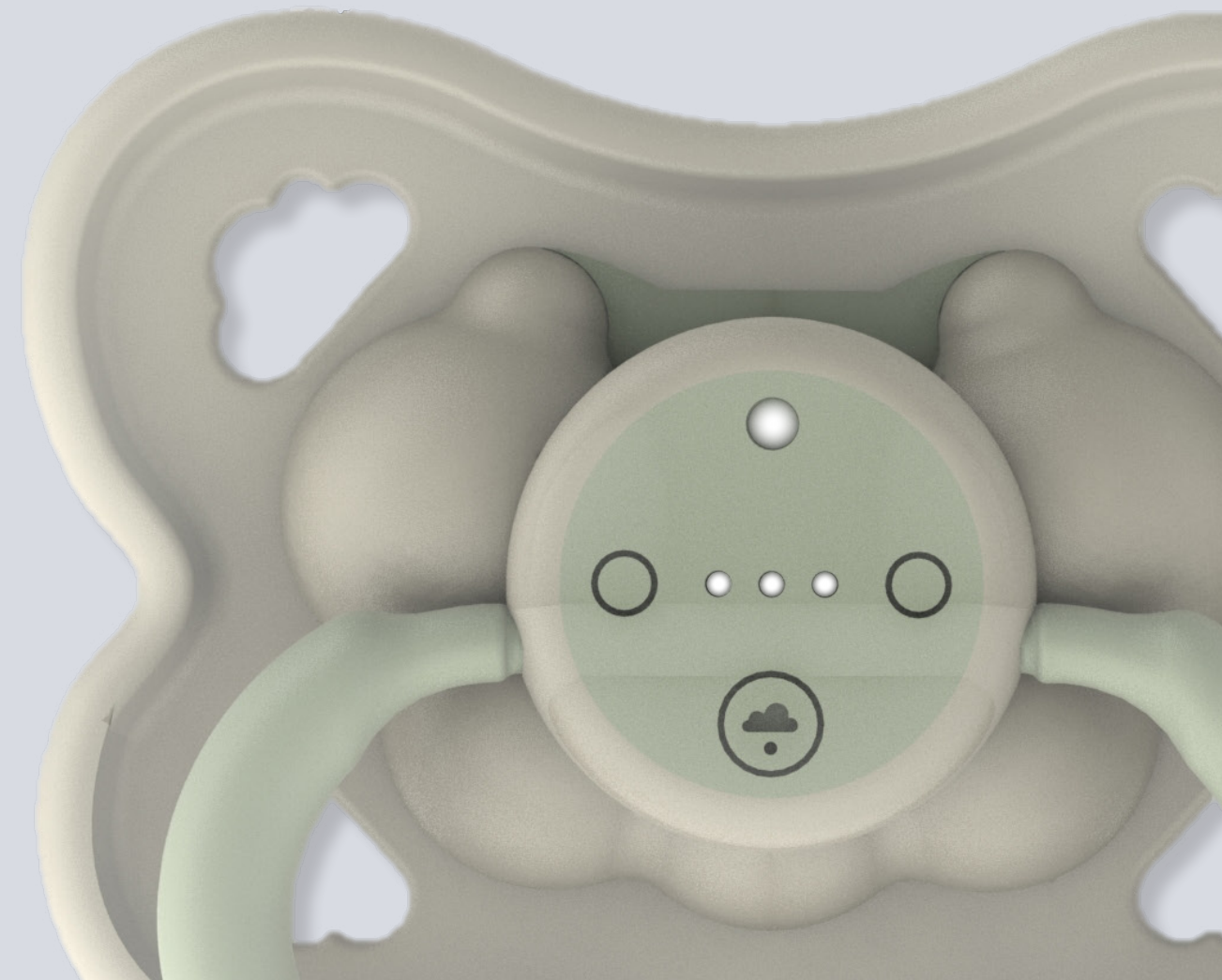
2 Designing for Dual Users – The product had to meet the physical comfort and safety needs of a baby, while also visually reassuring and guiding the parent—balancing aesthetics with silent communication.

FINAL
DESIGN



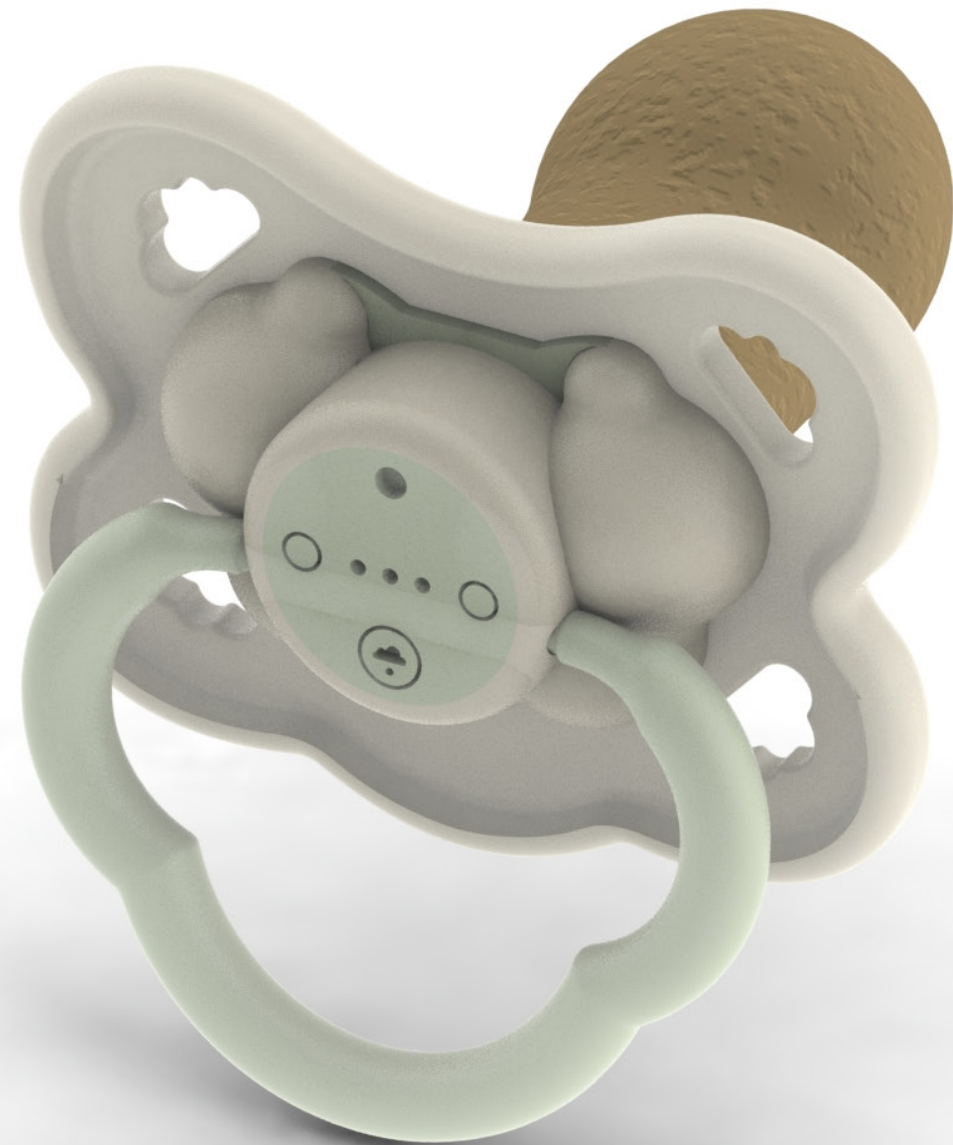
Ceila
gentle tech for tiny lives

Soothe. Monitor. Protect.

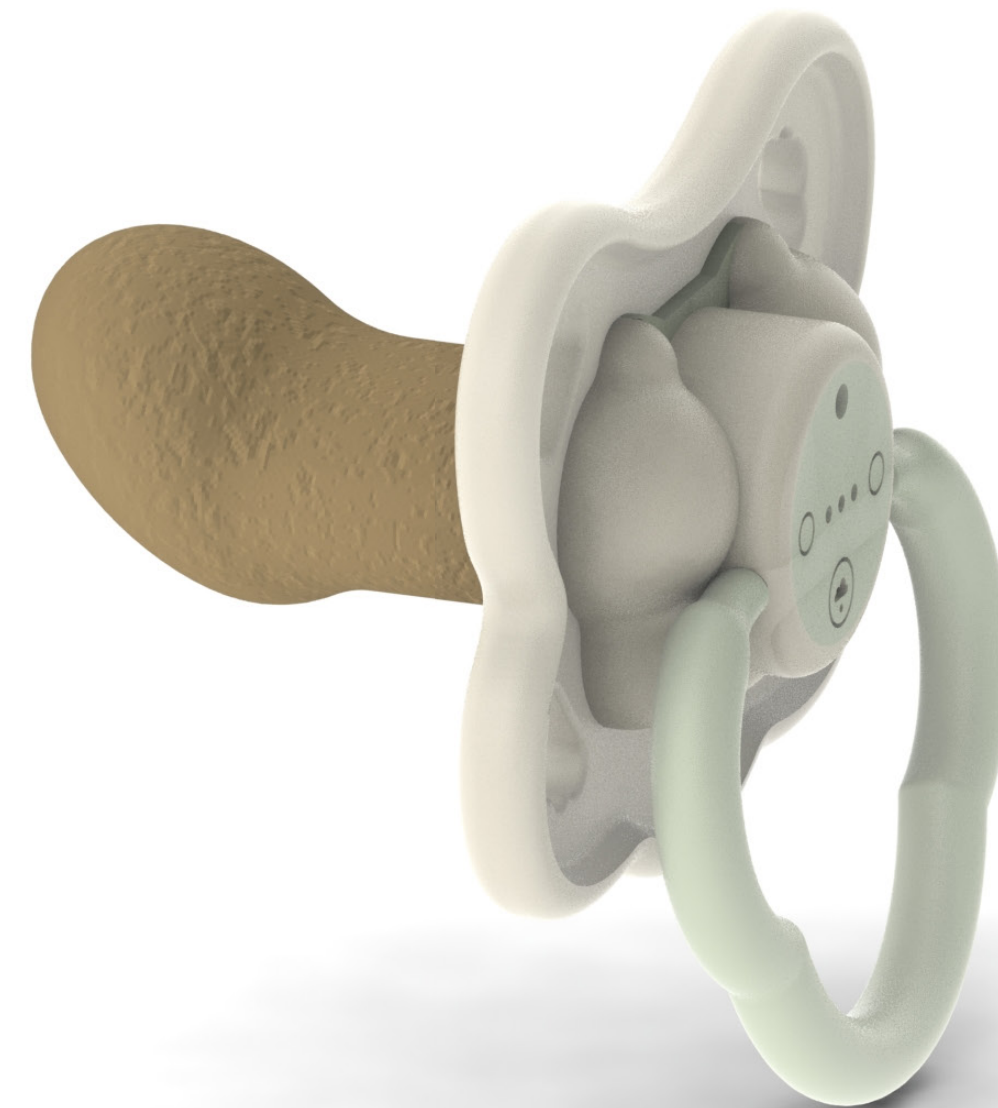


FINAL MODEL





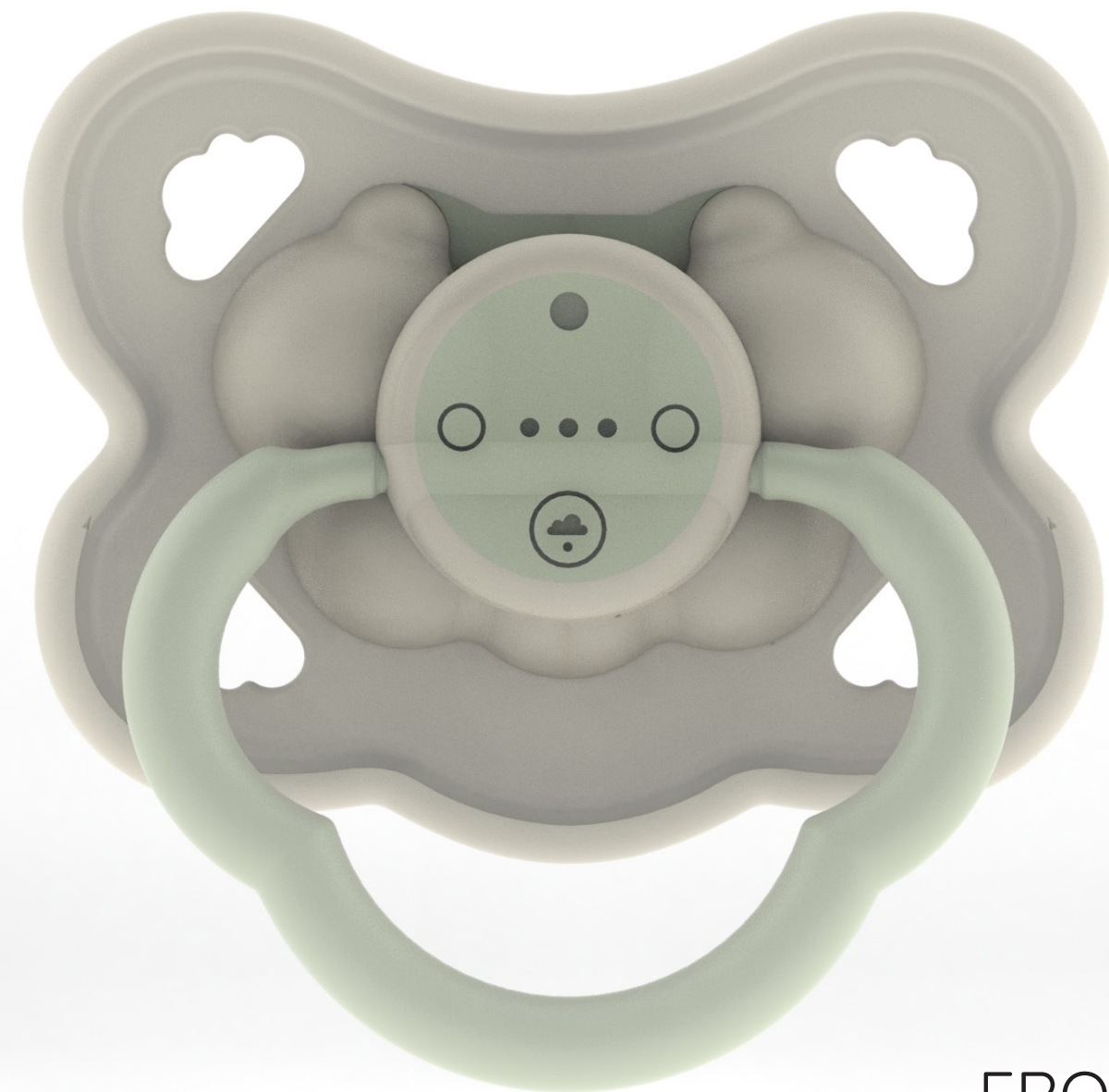
ABOVE RENDER



SIDE RENDER



BACK RENDER

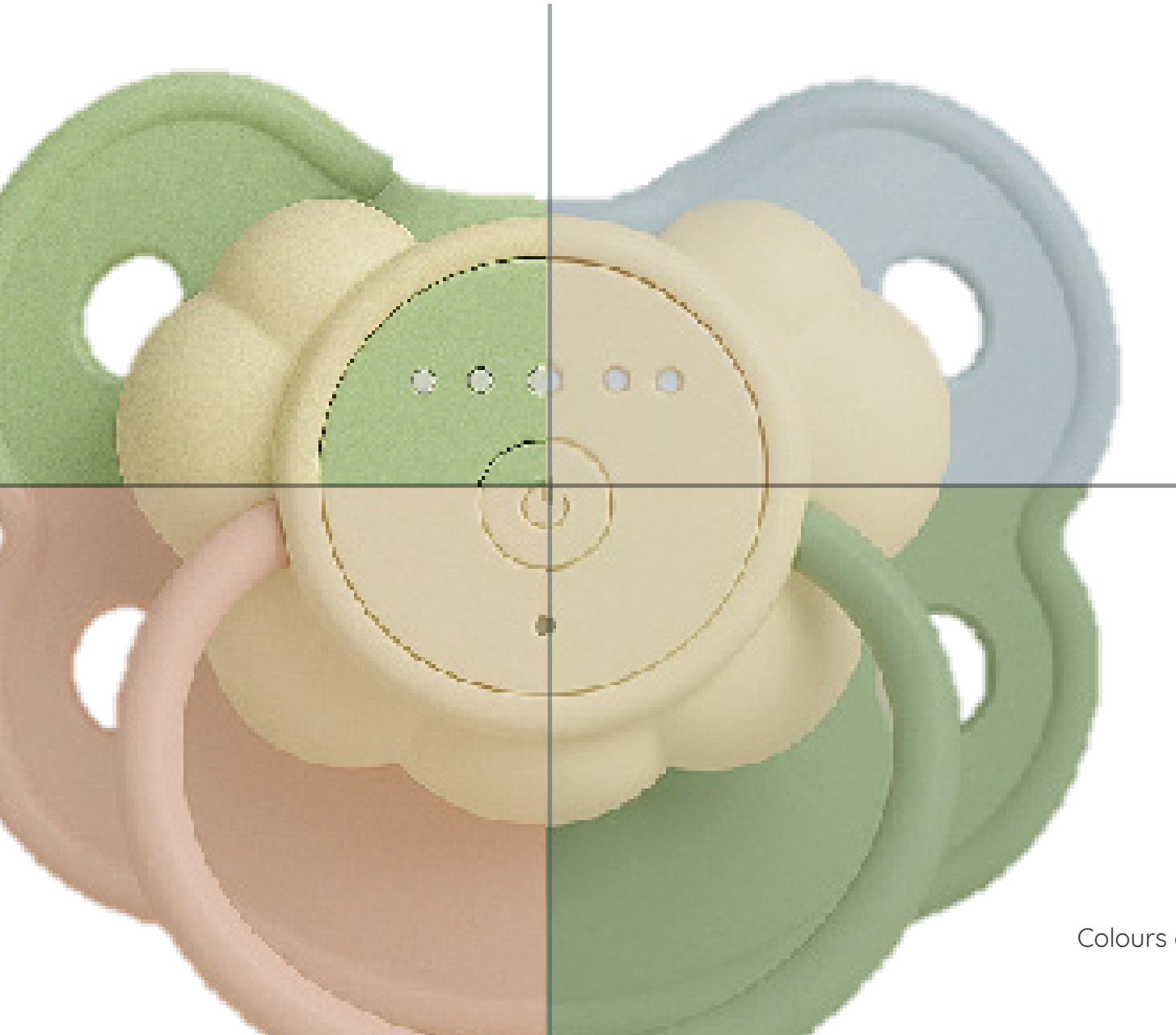


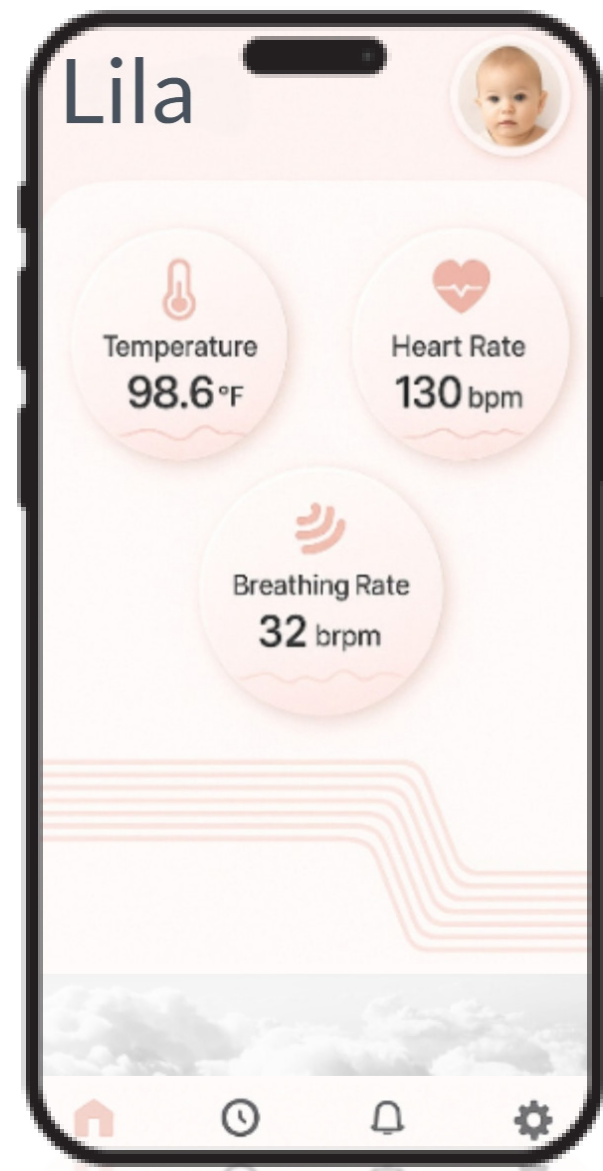
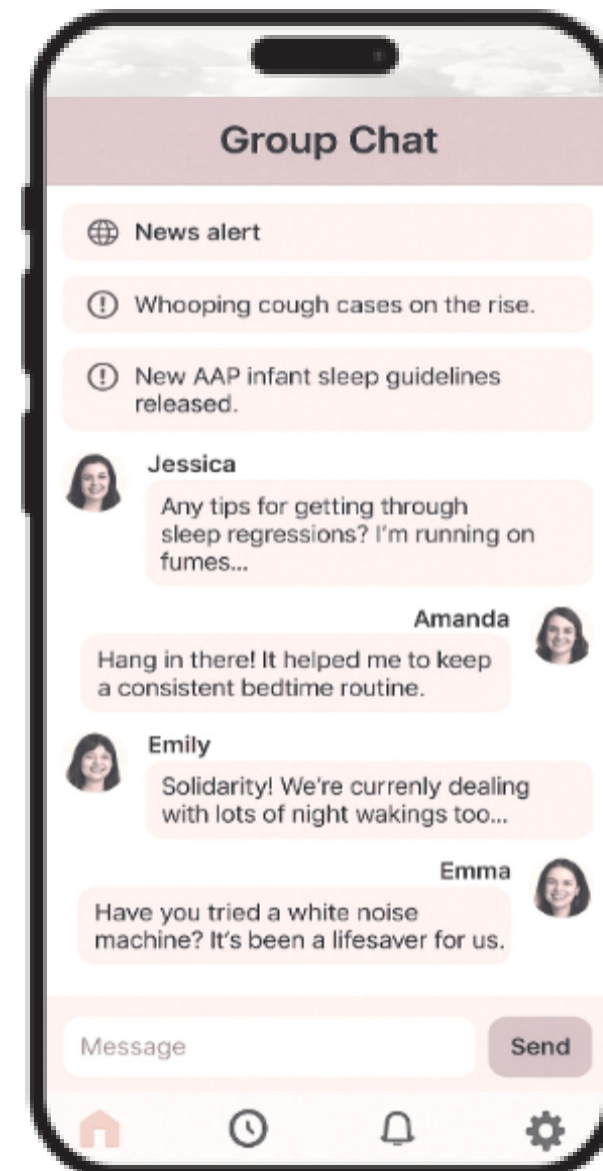
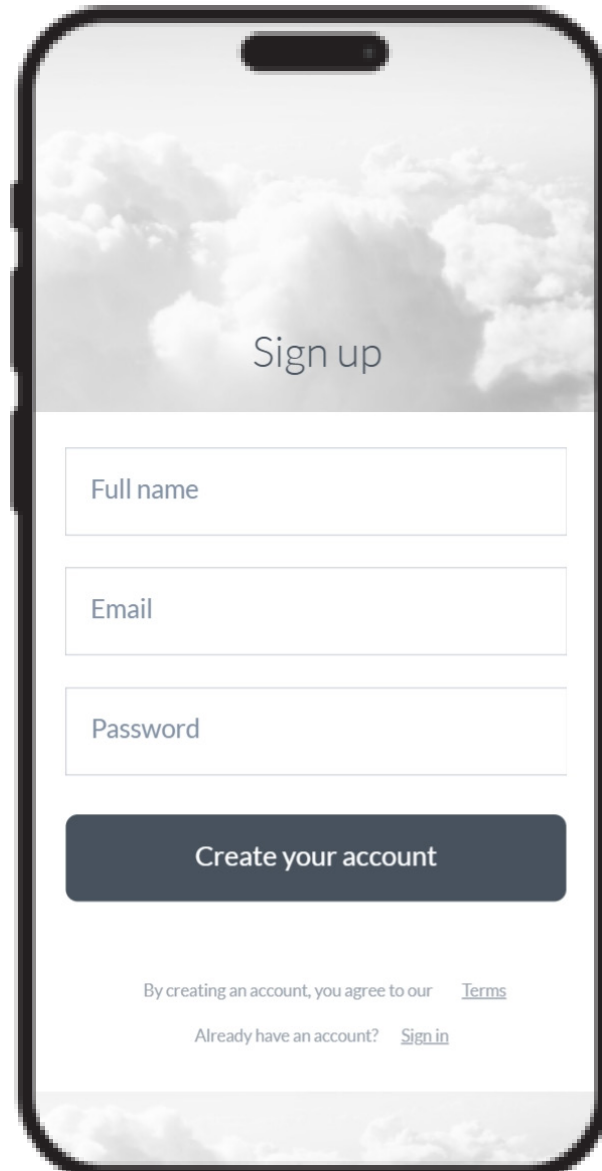
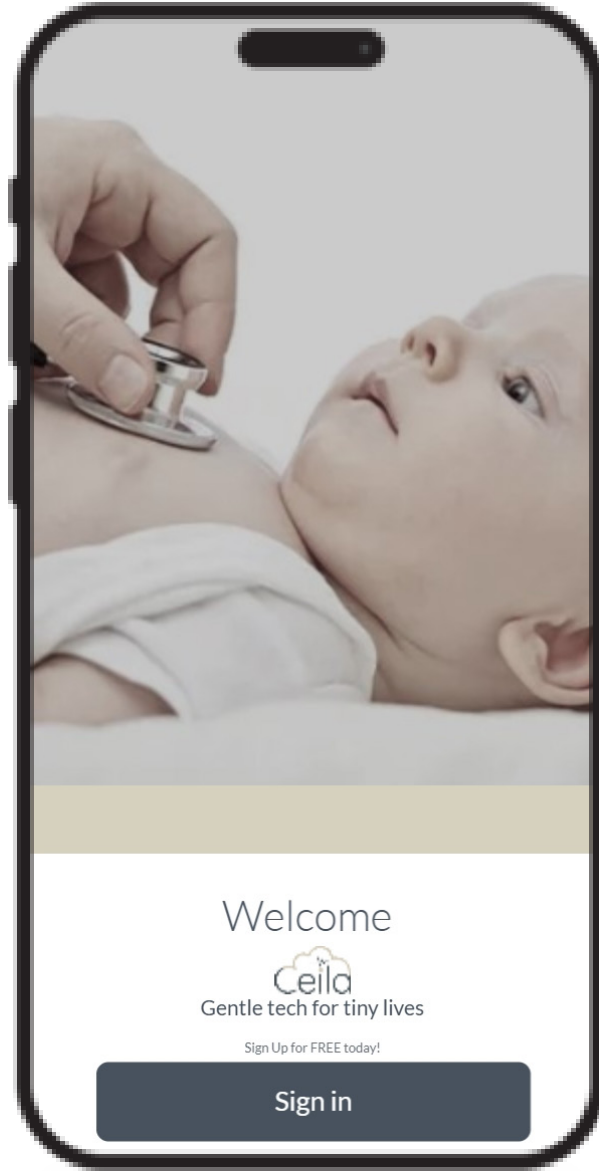
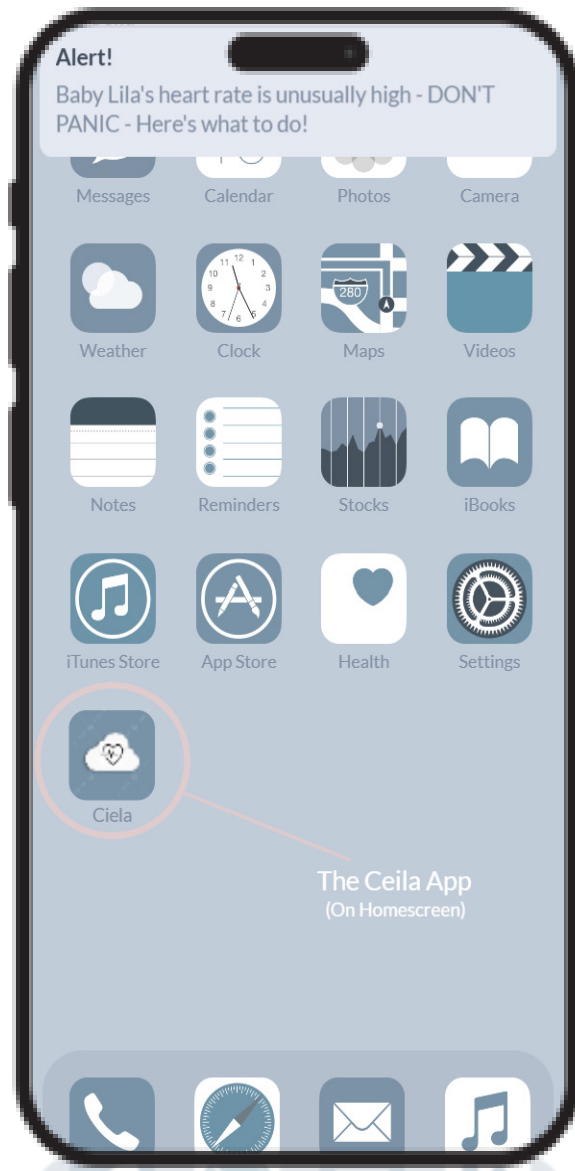
FRONT RENDER

COLOUR EXPLORATION

I chose a soft cream and pale green
colour palette to create a calming, gen-
der-neutral aesthetic that feels modern
and in line with current design trends,
offering a fresh and clean look without
appearing overly bright or tacky.

Colours explored but not chosen







LOGO DEVELOPMENT



THANK YOU

LARA FINLAY
6263PDE 20-25

