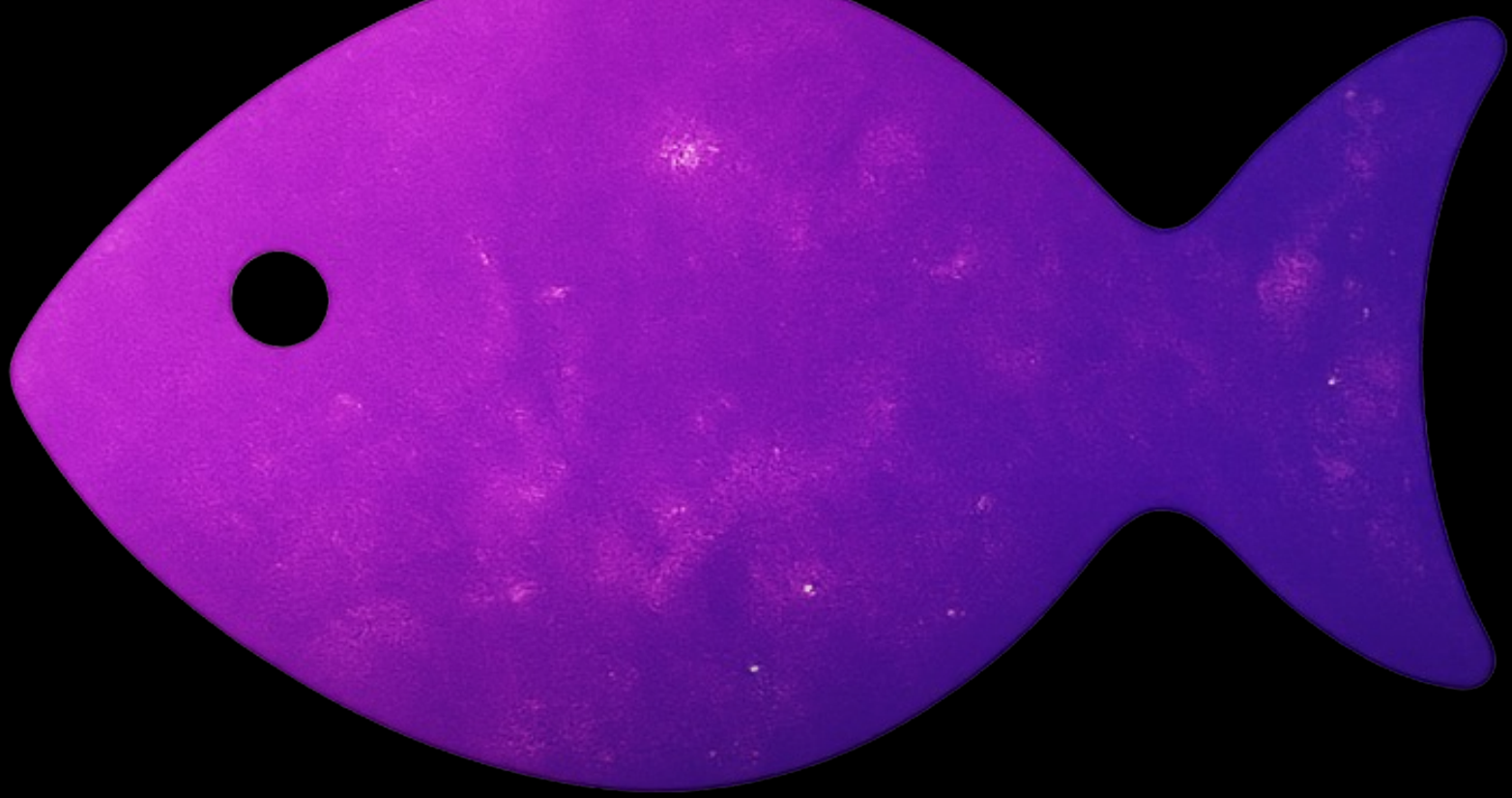
A Haptic Companion for Calm.



Andoor.

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Human-Centered Product Design, Advised by Prof. Isis Shiffer

Contents

Branding

Tagline: The comfort that responds.

Color Palette

- Violet (deep purple) → Galaxy
- Magenta (vibrant pink) → Dream
- Teal (deep blue) → Calming

Key Message

- Safety and comfort through sensory support
- Fusion of soft materials with responsive technology
- Unique therapeutic tool

Branding

Bengali Part

Adoor /aḍʊɾ/ -আদর

- Bengali word meaning affection, deep comfort, and unconditional love
- One of the sweetest words in Bengali Lanuage

Chinese Part

- An (安) "peace" or "tranquility".
- to lead a life of serenity, gentleness, and tranquility
- Unique therapeutic name

Problem Definition

“How can we better support individuals with

sensory processing sensitivities and emotional regulation challenges,

offering them ***calm and comfort*** in an ***accessible and non-stigmatizing*** way?”

Problem Definition *Target Market*

Prevalence (6-12 yo)

- **Total Neurodivergent:** Approx. 23% (~7.9 million children) with neurodevelopmental conditions.
- **Autism Spectrum Disorder (ASD):** 2.8% (~1.2 million).
- **Attention-Hyperactivity Disorder (ADHD):** 9.8% (~4.1 million).

Market Needs

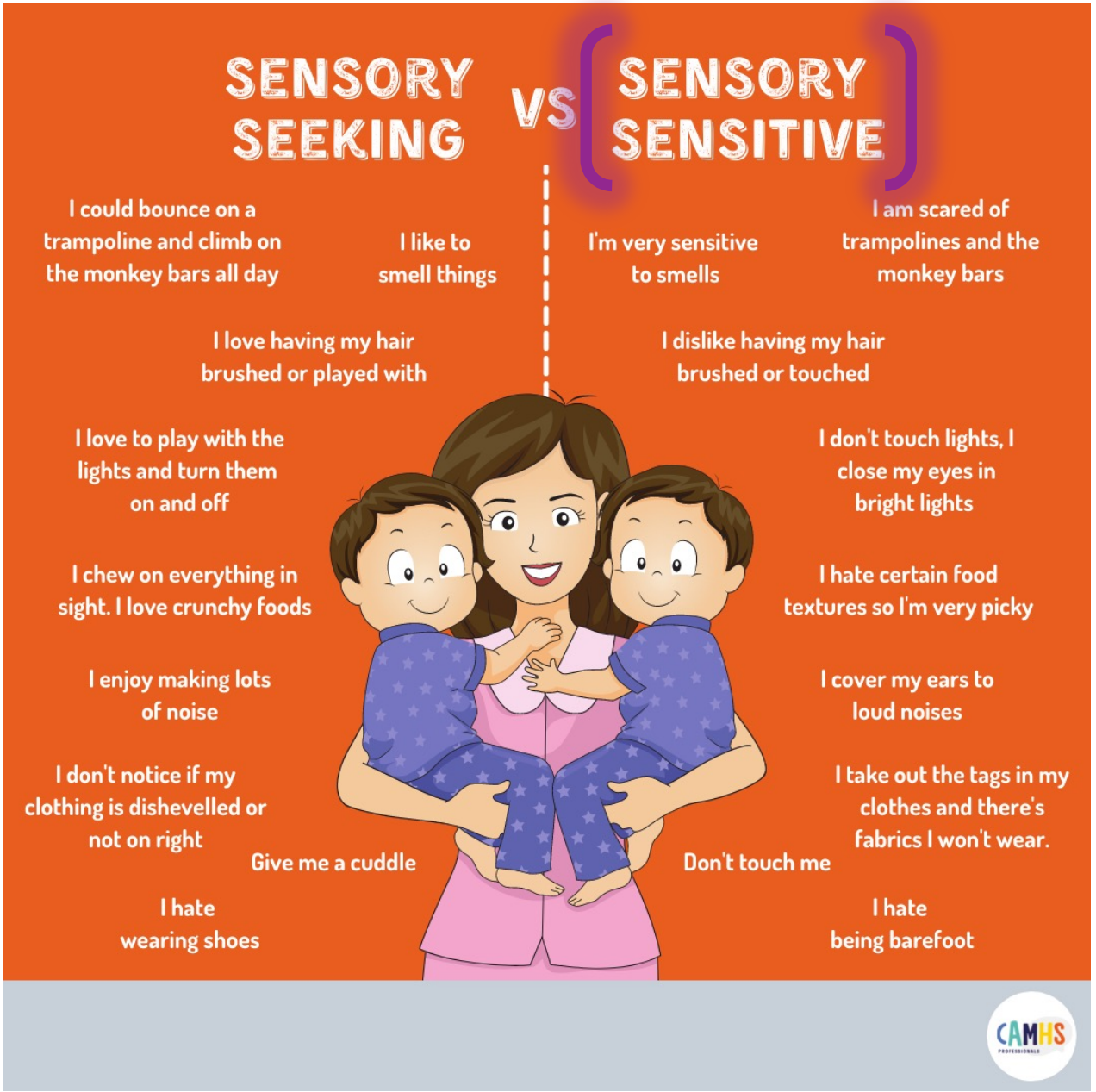
- **Sensory Intervention:** Clinical guidelines indicate 60-80% of neurodevelopmental cases demonstrate sensory processing differences requiring intervention.
- **Regulation Tools:** An estimated 85% of this population require sensory regulation tools.

Access Gaps

- **Availability:** Only 31-42% currently have access to appropriate devices or tools.
- **Diagnosis Bias:** ASD diagnosis shows a significant 4:1 male-to-female ratio, suggesting potential underdiagnosis in females who may present differently.

Problem Definition

Target Audience



Problem Definition
Issue Breakdown

Core Challenge

Neurodivergent children experience

- heightened sensitivity (lights, sounds, textures) or under-responsiveness,
- increased anxiety, distress, meltdowns, and
- challenges in communication and social engagement.

Current Gaps & Opportunities

- Many existing tools are clinical, stigmatizing, or purely functional (e.g., basic fidgets)
- Advanced therapeutic tools (robots like Paro, NAO) are often expensive and inaccessible
- Need for tools integrating *calming sensory input* with *appealing, comforting design*.

Concept Research
Historical References

Early years

- Plush toys and blankets provide basic comfort
- Limited focus on sensory needs

Mid-20th Century

- Basic electronic toys
- Focus still primarily on entertainment

1970s-90s

- Early therapeutic tools appear in clinical settings
- Growing awareness of developmental & sensory needs (e.g., Sensory Integration theory)

2000s

- More sophisticated sensory tools
- Integration of interactive technology (e.g., Paro)

2010s+

- Smart, connected devices
- Increased research into haptics, biofeedback, and technologies for neurodevelopmental support
- Focus shifts towards integrating therapy with user-friendly design

Concept Research
Trend Analysis

Market Gap	Affordable, accessible advanced sensory tools
	Less clinical, more comforting form factors integrating technology
	Tools promoting active self-regulation through simple interaction
Tech Insights	*Input:* Tactile/Pressure sensors are widely used and effective
	Output: Haptic feedback (vibration) shows strong potential to impact the nervous system
	Biofeedback: Heart rate monitoring offers future potential but adds complexity/cost
Opportuni-ties	Leverage the proven effectiveness of pressure input and the therapeutic potential of rhythmic haptic feedback.
	Focus on creating a simpler, more accessible device compared to complex robots, by integrating these core technologies into a soft, user-friendly form.

Concept Research
Design Hypothesis

Neurophysiological Rationale

- **Problem**
  - Stress and sensory overload trigger physiological responses *(↑ cortisol, ↑ heart rate, ↓ HRV)*
  - Sympathetic nervous system ("fight or flight") is activated
- **Action**
  - Specific sensory inputs are theorized to engage pathways *(mechanoreceptors → thalamus → insula → vagal nerve)*
  - Parasympathetic activity ("rest and digest") is promoted

Core Hypothesis

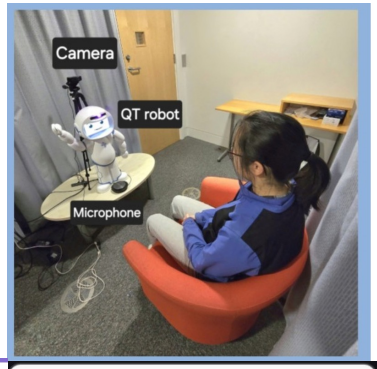
- Specifically patterned, **rhythmic haptic feedback**, delivered through a comforting **tactile interface**, can facilitate autonomic nervous system regulation by promoting parasympathetic activity
- This will lead to measurable **reductions in physiological stress** indicators and improve subjective feelings of calm and emotional self-regulation in users, particularly those with sensory processing sensitivities

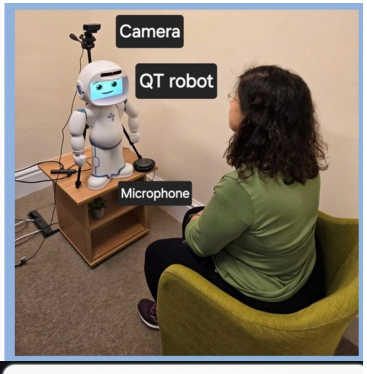
Concept Research
Design Thesis

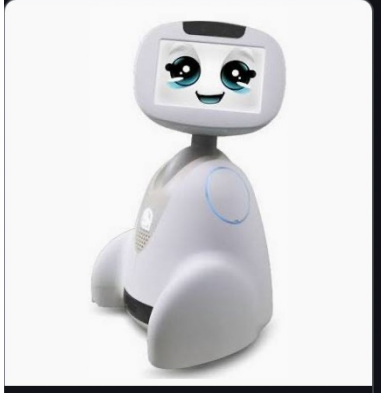
"By creating a soft, huggable companion that integrates pressure sensors for gentle, rhythmic haptic feedback, we can offer an accessible, engaging, and effective tool for individuals to self-manage sensory sensitivities and promote emotional calm through direct physiological pathways."

Market Research *Current Designs Available*

Current ones are expensive, tough to manufacture for lower income countries, need maintenance







Blue Frog Robotics Buddy Social Robot

$4,890.00

Wellbots

$4,880 with code

ZoraBots Nao V6 w/ Zora Solution

$14,292.00

RobotShop.com

Free shipping

Concept Research
Interview-Based User Personas

Lin, a stressed creative student

- *Needs:* Stress relief (work/boredom), tactile comfort (soft, warm, squeezable), connection/creative outlet.
- *Wants:* A comforting object for bed, impressive "wow" factor, potentially gentle sound.
- *Pain Points:* Stress, finding effective relaxation tools.

Emma, a 4-yo ASD child

- *Needs:* Comfort when sad/scared, safety (darkness), soft/huggable companion.
- *Wants:* Super soft, colorful, friendly object; big hugs; gentle giggles/lights; magical feel.
- *Pain Points:* Fear of the dark, sadness.

Ideation & Prototyping
Research-Driven Design Decisions

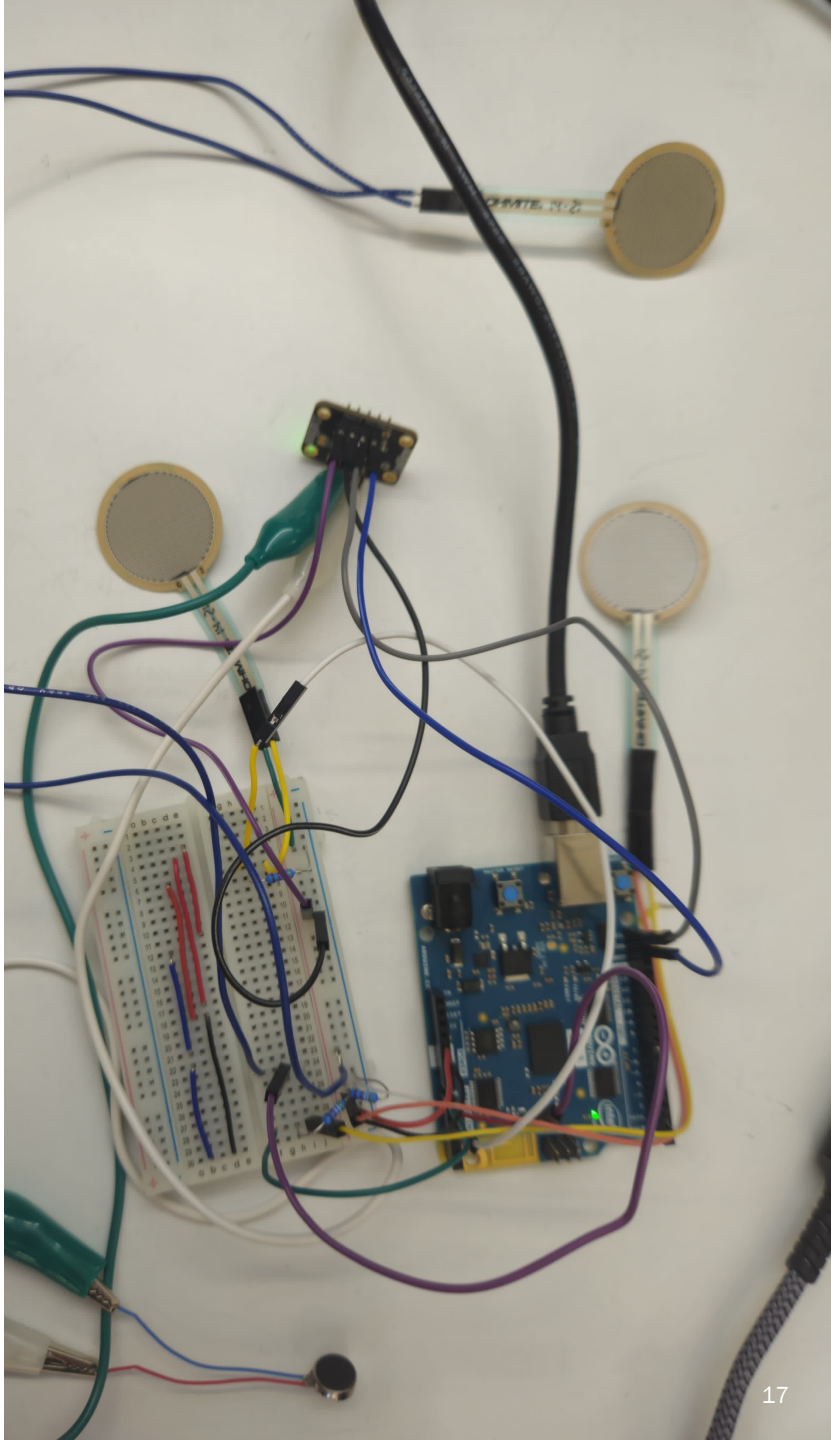
- **Focus on Haptic Feedback** for its potential in autonomic regulation
- **Employ Pressure Sensors** than biofeedback for its proven effectiveness, intuitive interaction (hug/squeeze), and simplicity
- **Adopt Soft, Comforting Form** for comfort, differentiating from clinical devices
- **Prioritize Simplicity & Accessibility** to fill gap between low-tech items and expensive robots
- **Embed Safety & Durability** to follow best practices for therapeutic/children's products.

Ideation & Prototyping
Input Selection

- **Attempt:** Explored biofeedback using a heart rate sensor connected to an Arduino Nano and vibration motor.
- **Issue:** Encountered issues with heart rate sensor accuracy and ease of consistent use, leading to concerns about reliability.
- **Pivot:** Switched to Force Sensing Resistors (FSRs) / pressure sensors for a more direct and reliable interaction method (detecting hugs/squeezes).

Ideation & Prototyping
Arduino Buildup

- Successfully programmed the Arduino Nano to read input from multiple FSRs.
- Developed algorithm to trigger the vibration motor based on sensor input thresholds.
- Verified functionality of the complete electronics module (Arduino + sensors + motor) on the breadboard.



Ideation & Prototyping
Testbed Integration

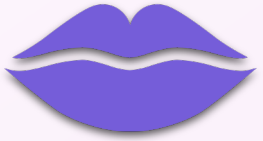
- Utilized an existing rabbit-shaped purse as a readily available soft form for initial component testing and placement exploration.
- Placed sensors and motor onto/into the rabbit purse for physical testing.
- Noted a slight decrease in perceived vibration intensity when the motor was placed inside the plush material, but the effect remained noticeable and strong.

User Testing *Haptic Modes*

The testing users were given two options for the haptic feedback.

“Record & Replay Hugs”

The device records the pattern/duration of squeezes and then replays a corresponding vibration sequence based on user input.



“Vibe(rate) with Hugs”

The device vibrates directly and immediately in response to pressure applied to the sensors.

Testing & Iteration *Haptic Modes*

- **User Feedback on Modes:**
    - **Preference Split:** 1 out of 3 users preferred Mode 1; 2 out of 3 users preferred Mode 2.
    - **Mode 1 Feedback (Pro):** Liked the idea of the toy "remembering" and syncing with the interaction.
    - **Mode 1 Feedback (Con):** Perceived delay led to confusion (doubts about malfunction), required learning/guessing, users lacked patience for the recording phase.
    - **Mode 2 Feedback (Pro):** Appreciated the immediate responsiveness and strong, direct vibration feedback; felt intuitive.
    - **Decision:** Proceed with **Mode 2 ("Vibrate with Hugs")** due to majority preference and lower learning curve/confusion.
- **Form Factor Feedback:**
    - **Positive Review:** Users liked the soft and furry fabric and responsive haptics.
    - **Critical Insight:** Users noted the specific rabbit prototype's eyes appeared "intimidating."
    - **Decision:** This feedback necessitates **rethinking the visual design and form factor** of the final product. The focus shifts away from this specific rabbit aesthetic towards a more universally friendly and less potentially unsettling appearance.

Testing & Iteration *Next Steps*

1

Interaction Model

- Use of **real-time** haptic feedback (“vibrate with hugs”) triggered by pressure sensors (FSRs).

2

Form Factor

- Significant **redesign** required.
- Move away from potentially intimidating features (like the tested rabbit's eyes).

3

Objective

- Create a universally appealing, huggable form.
- Maintain focus on **ultra-soft/stuffed** materials.

Final Prototype
Materials

Refined Prototype *Manufacture*

Refined Prototype *Face Design*

Product Lifecycle
Production Materials

Product Lifecycle *End-of-Life Strategy*

Design for Disassembly: Facilitate separation of electronic components from textile parts (e.g., accessible internal pouch)

Material Labeling: Clearly identify materials for proper sorting (textiles, plastics, e-waste), including WEEE symbol

Disposal Guidance: Instruct users on responsible disposal routes, i.e., e-waste recycling for electronics, textile recycling/donation for fabric body

Reduce Environmental Impact: Explore options for take-back programs or use of recycled/renewable materials where feasible.

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