UNIVERSITI TEKNOLOGI MALAYSIA

SECP1513 PROJECT DESIGN THINKING

SECTION : 05

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DATE OF SUBMISSION : 11TH JANUARY 2026

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Introduction

As a group of students, we've always been interested in how technology can move beyond being just a gadget and actually become a lifeline. While exploring assistive tech, we noticed that while there are plenty of fitness trackers for athletes, there's a massive gap when it comes to tools designed for the sensory and safety needs of neurodivergent individuals. For autism people, the world can be physically overwhelming. A sudden spike in anxiety or a sensory meltdown isn't just an "emotional" event, it's a physiological one. We realized that if we could track what's happening inside the body, we could help support the user before things get out of control.

Our project is a "Sensory Touch" smartwatch prototype designed to act as both a monitor and a comforter. The watch is equipped with sensors to track **blood pressure, heart rate, pulse, body temperature, and sleep behaviour** in real-time. Because individuals with autism may sometimes struggle to communicate what they are feeling, the watch does the talking for them. If the sensors detect a sudden, sharp increase in heart rate or pulse which indicators of anxiety or high stress, it will immediately send a notification to a mobile app held by their parent or caregiver. This gives the caregiver a "heads up" to intervene early, even if they aren't in the same room.

To build this, we followed the **Design Thinking** process. It was a huge learning curve for us, so we had to move past just "cool tech" and really think about the ethics of monitoring and the comfort of the wearer. We spent hours debating how to make the watch feel natural and not like a medical device, and how to make the app interface clear enough for a parent to understand at a glance during an emergency. This report covers our whole journey, the messy brainstorming, the technical issues of getting the sensors to sync, and the heart we put into creating something that could give families a little more peace of mind.

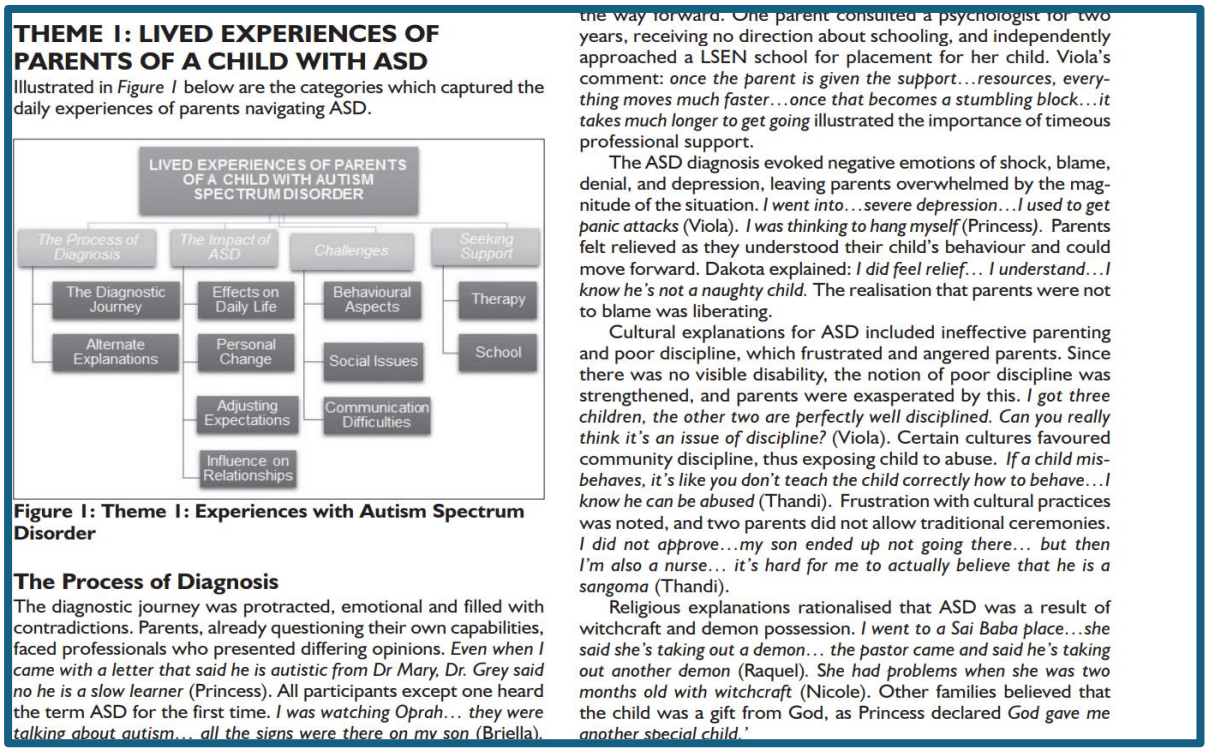
Detail Steps & Description

Phase 1: Empathize (Learning the "Why")

The Goal: To understand the daily struggles of parents and the sensory world of people with autism.

- **What we did:** We found research revealed the parenting of children with autism. We learned that parents live in a state of constant stress, always watching for triggers which is exhausting.

- **Evidence:** Research Paper



THEME 1: LIVED EXPERIENCES OF PARENTS OF A CHILD WITH ASD

Illustrated in *Figure 1* below are the categories which captured the daily experiences of parents navigating ASD.

Figure 1: Theme 1: Experiences with Autism Spectrum Disorder

The Process of Diagnosis

The diagnostic journey was protracted, emotional and filled with contradictions. Parents, already questioning their own capabilities, faced professionals who presented differing opinions. *Even when I came with a letter that said he is autistic from Dr Mary, Dr. Grey said no he is a slow learner* (Princess). All participants except one heard the term ASD for the first time. *I was watching Oprah… they were talking about autism… all the signs were there on my son* (Briella).

the way forward. One parent consulted a psychologist for two years, receiving no direction about schooling, and independently approached a LSEN school for placement for her child. Viola's comment: *once the parent is given the support…resources, everything moves much faster…once that becomes a stumbling block…it takes much longer to get going* illustrated the importance of timeous professional support.

The ASD diagnosis evoked negative emotions of shock, blame, denial, and depression, leaving parents overwhelmed by the magnitude of the situation. *I went into…severe depression…I used to get panic attacks* (Viola). *I was thinking to hang myself* (Princess). Parents felt relieved as they understood their child's behaviour and could move forward. Dakota explained: *I did feel relief… I understand…I know he's not a naughty child.* The realisation that parents were not to blame was liberating.

Cultural explanations for ASD included ineffective parenting and poor discipline, which frustrated and angered parents. Since there was no visible disability, the notion of poor discipline was strengthened, and parents were exasperated by this. *I got three children, the other two are perfectly well disciplined. Can you really think it's an issue of discipline?* (Viola). Certain cultures favoured community discipline, thus exposing child to abuse. *If a child misbehaves, it's like you don't teach the child correctly how to behave…I know he can be abused* (Thandi). Frustration with cultural practices was noted, and two parents did not allow traditional ceremonies. *I did not approve…my son ended up not going there… but then I'm also a nurse… it's hard for me to actually believe that he is a sangoma* (Thandi).

Religious explanations rationalised that ASD was a result of witchcraft and demon possession. *I went to a Sai Baba place…she said she's taking out a demon… the pastor came and said he's taking out another demon* (Raquel). *She had problems when she was two months old with witchcraft* (Nicole). Other families believed that the child was a gift from God, as Princess declared *God gave me another special child.'*

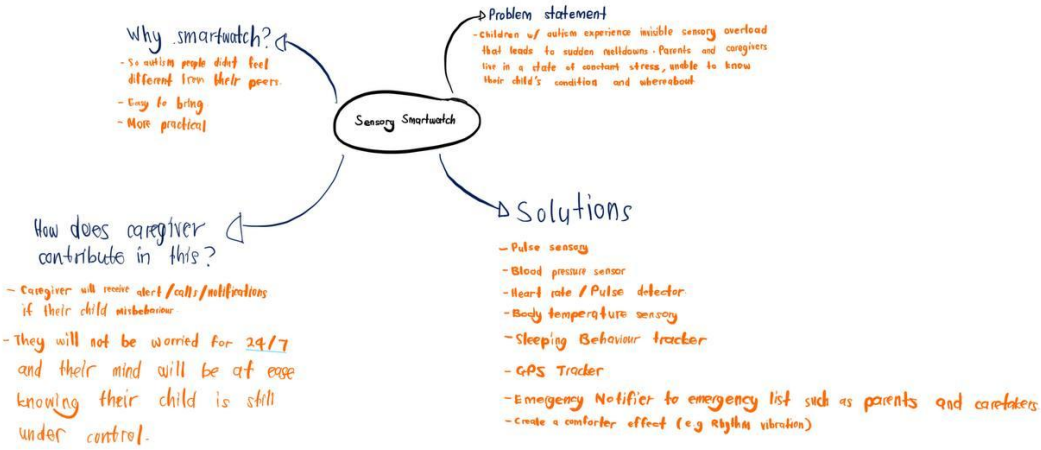
  - **Sensory Overload:** *The paper highlights that individuals with autism often experience sensory overload. Common environments (loud noises, bright lights, crowds) can trigger tantrums and meltdowns.*

Phase 2: Define (Finding the Problem)

The Goal: To narrow down our focus from "helping people with autism" to a specific technical problem.

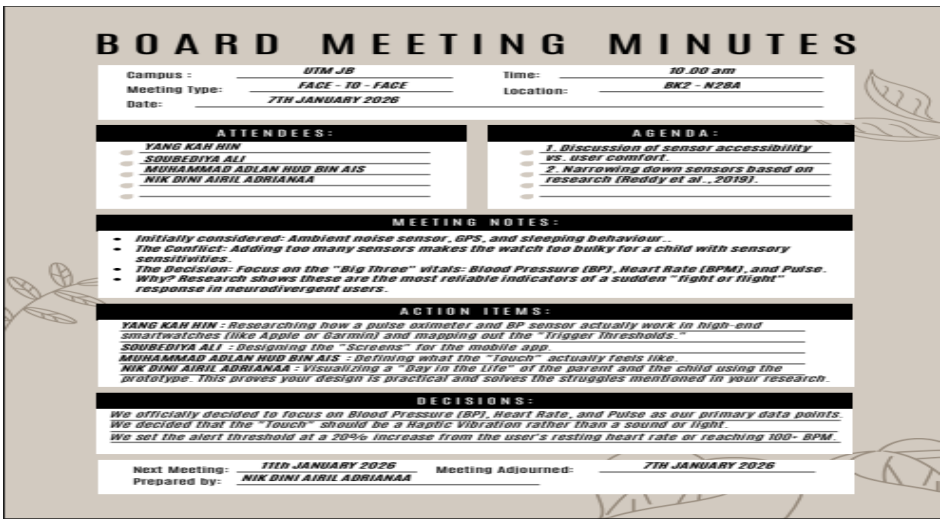
- **What we did:** We realized the biggest issue wasn't just the stress itself, but the **communication gap** when a user is non-verbal or overwhelmed. We defined our Point of View (POV): *"A child with autism needs a way to auto-report physiological stress because they cannot always vocalize their needs when they are feeling overwhelmed."*

- **Evidence:**



  - Our final "Problem Statement" is written on a whiteboard.

  - **Team Progress:** Meeting Minute



BOARD MEETING MINUTES

Campus : UTM JB
Meeting Type: FACE - TO - FACE
Date: 7TH JANUARY 2026
Time: 10.00 am
Location: BK2 - N28A

ATTENDEES:
- YANG KAH HIN
- SOUBEDIYA ALI
- MUHAMMAD ADLAN HUD BIN AIS
- NIK DINI AIRIL ADRIANAA

AGENDA:
1. Discussion of sensor accessibility vs. user comfort.
2. Narrowing down sensors based on research (Reddy et al., 2019).

MEETING NOTES:
- Initially considered: Ambient noise sensor, GPS, and sleeping behaviour.
- The Conflict: Adding too many sensors makes the watch too bulky for a child with sensory sensitivities.
- The Decision: Focus on the "Big Three" vitals: Blood Pressure (BP), Heart Rate (BPM), and Pulse.
- Why? Research shows these are the most reliable indicators of a sudden "fight or flight" response in neurodivergent users.

ACTION ITEMS:
YANG KAH HIN : Researching how a pulse oximeter and BP sensor actually work in high-end smartwatches (like Apple or Garmin) and mapping out the "Trigger Thresholds."
SOUBEDIYA ALI : Designing the "Screens" for the mobile app.
MUHAMMAD ADLAN HUD BIN AIS : Defining what the "Touch" actually feels like.
NIK DINI AIRIL ADRIANAA : Visualizing a "Day in the Life" of the parent and the child using the prototype. This proves your design is practical and solves the struggles mentioned in your research.

DECISIONS:
We officially decided to focus on Blood Pressure (BP), Heart Rate, and Pulse as our primary data points.
We decided that the "Touch" should be a Haptic Vibration rather than a sound or light.
We set the alert threshold at a 20% increase from the user's resting heart rate or reaching 100+ BPM.

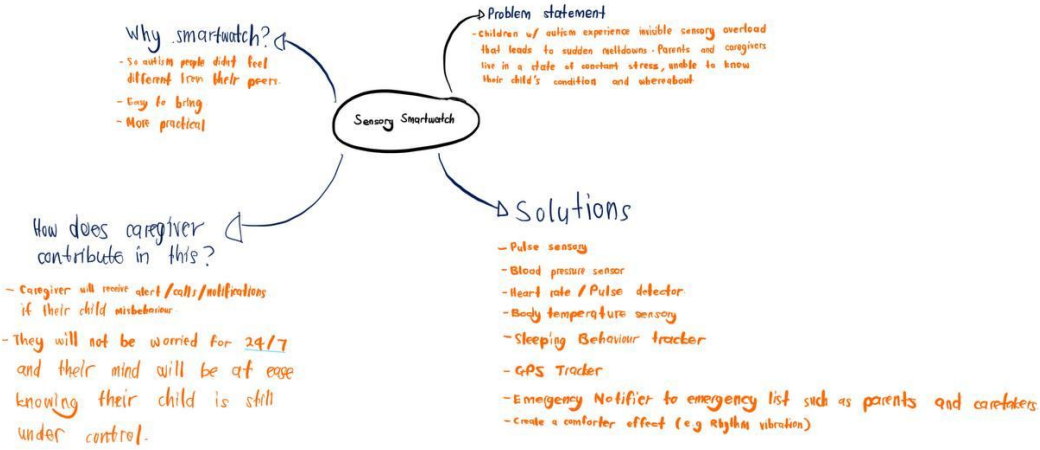
Next Meeting: 11th JANUARY 2026
Prepared by: NIK DINI AIRIL ADRIANAA
Meeting Adjourned: 7TH JANUARY 2026

Phase 3: Ideate (Brainstorming Solutions)

The Goal: To come up with as many ways as possible to solve the problem before picking the best one.

- **What we did:** We held a sketching session. Some ideas were too wild (like a full-body sensory suit), but we landed on the **Smartwatch + App** combo because it's discrete and uses existing wearable habits.

- **Evidence:**



  - **Brainstorming List:**

Category 1

Digital Hug Vibration	A slow, rhythmic pulsing pattern designed to mimic a human heartbeat or a firm, grounding touch on the wrist.
Temperature Regulation	A feature that cools or warms the watch face slightly to provide a distracting, grounding physical sensation during stress.
Squeeze Band	A conceptual motorized strap that could gently tighten on the wrist to simulate deep-pressure therapy.

Category 2

Emergency SOS Button	A physical, easy to find button on the side of the watch that the user can press for 3 seconds to send an immediate "I need help" alert to the caretaker.
Geo-Fencing Alerts	Using GPS logic so that if a child wanders outside of a "safe-zone" (like the school playground) during a meltdown, the parent is notified instantly.
Automatic Trigger	An "Auto-Vibrate" mode where the watch begins the "Digital Hug" the moment the heart rate crosses 100 BPM threshold.

Category 3

Real-Time Health Dashboard	A visual graph on the parent's mobile app showing live streams of Heart Rate, Pulse, and BP.
Stress History Log	A calendar view that records when and where spikes happened, helping parents identify environmental triggers (like loud music classes)
"Remote Pulse" Button.	A feature allowing the parents to manually trigger a vibration on the child's watch from their phone, letting the child know "I am here with you" even from a distance.

Phase 4: Prototype (Building the "SensorySync")

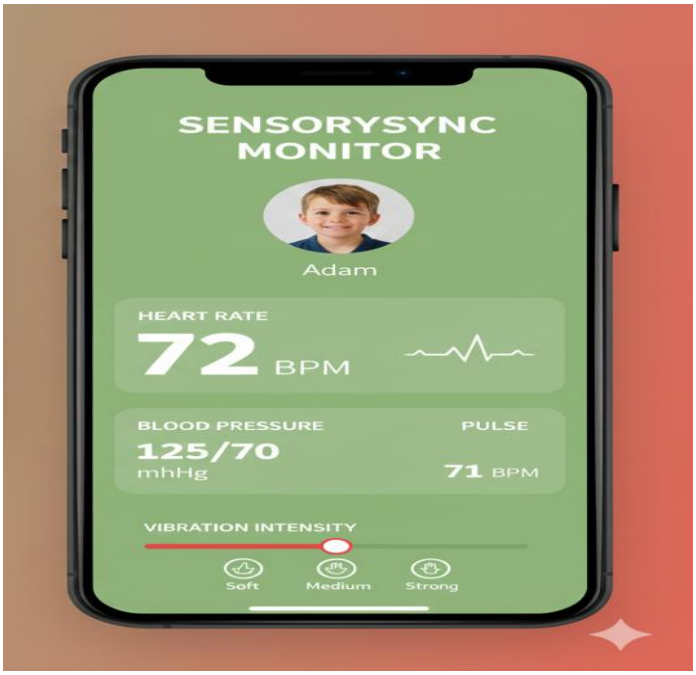
The Goal: To build a low-cost version of the watch and app to see if it actually works.

- **What we did:** We used an Arduino/ESP32 (or similar) to connect a pulse sensor to a small vibration motor. For the app, we designed the user interface (UI) to show "Green" when vitals are normal and "Red Alert" when the heart rate/BP spikes.
- **Evidence:**
    - A 30-second clip of the heart rate sensor being touched and the motor vibrating in response.
    - App wireframes showing the sample of caregiver's notification screen.

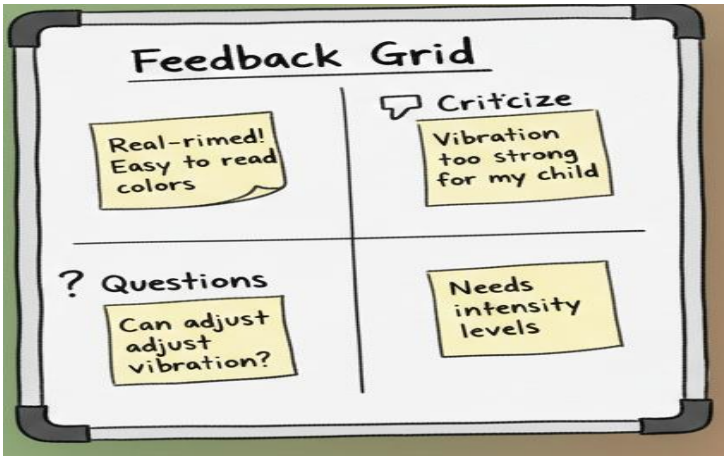
Phase 5: Test (User Feedback)

The Goal: To see if our solution actually helps the target audience.

- **What we did:** We showed our prototype to a peer who has experience with neurodiversity. They pointed out that the vibration should be adjustable, because some users might find a strong vibration *more* stressful.
- **Evidence:**
    - **Log Journal Entry:** *"Week 10: Testing revealed that the 'Sensory Touch' needs three levels of intensity. We updated the app to allow the parent to choose the vibration strength."*



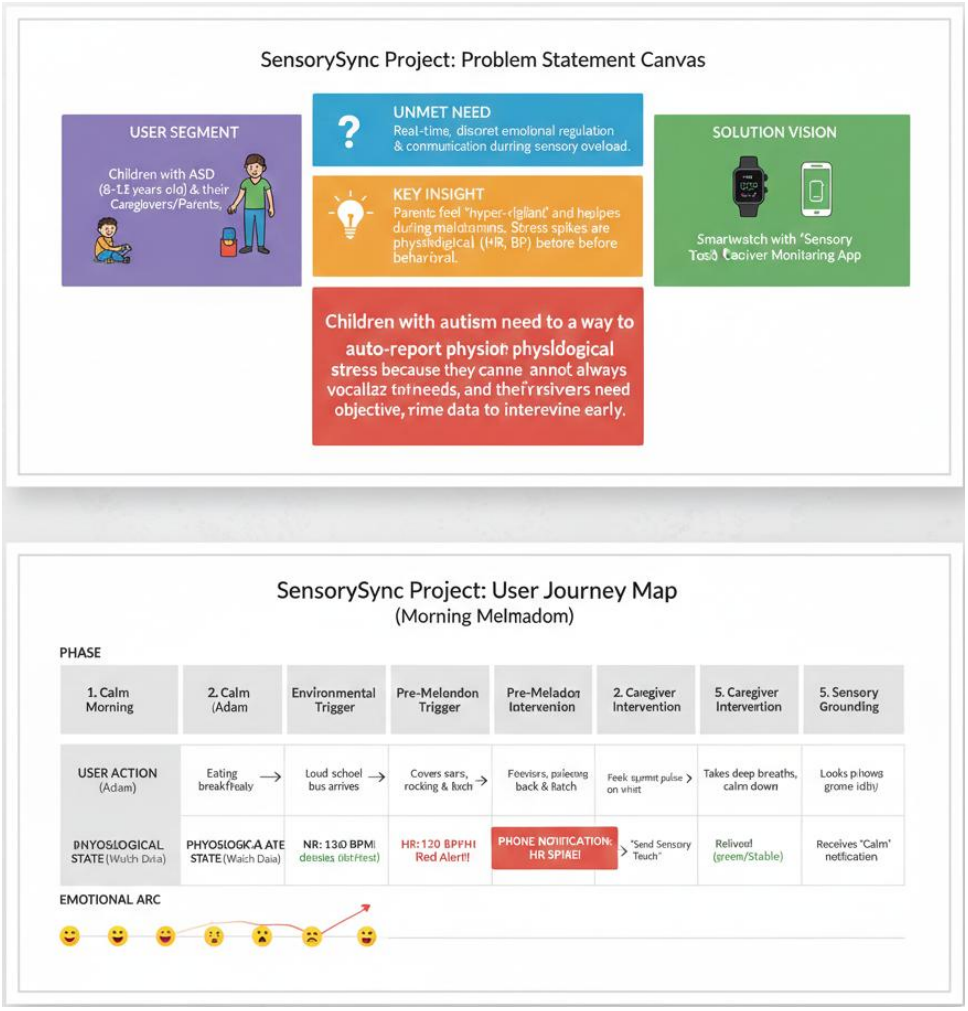
    - A "Feedback Grid" showing what users liked, criticized, and questioned.



Detailed Descriptions

The Problem : The Invisible Crisis

- **For the Caregiver (Parent):** Parents live in a state of hyper-vigilance. They are constantly worrying about their child's state while at school or with others. This "burden of care" leads to chronic stress and exhaustion because they lack objective, real-time data on their child's wellbeing.



The Solution: SensorySync Dual-System

- **The "Sensory Touch" Smartwatch (Monitoring) :** The watch is equipped with conceptual **Blood Pressure, Heart Rate, and Pulse** sensors. It acts as the child's "internal voice," monitoring vitals that indicate rising stress levels.

- **The Caregiver App (The Dashboard):** A simplified "Traffic Light" interface (Green/Yellow/Red) that allows parents to evaluate their child's state immediately.

    - **Remote Intervention:** If a spike is detected, the parent receives an instant notification. They can then remotely trigger the watch and moving from "worrying" to "taking action."

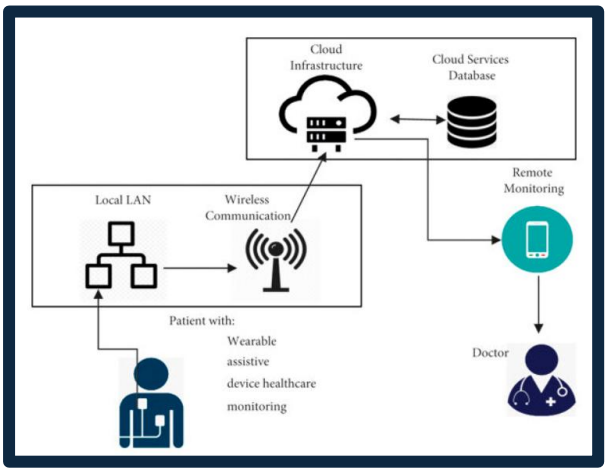


Figure 1 (App Mockups)

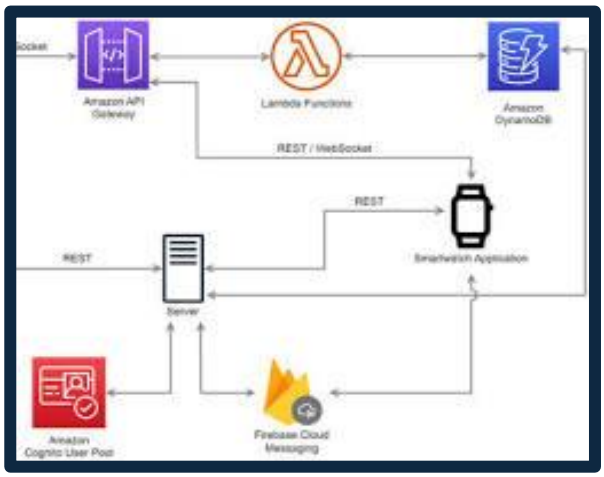


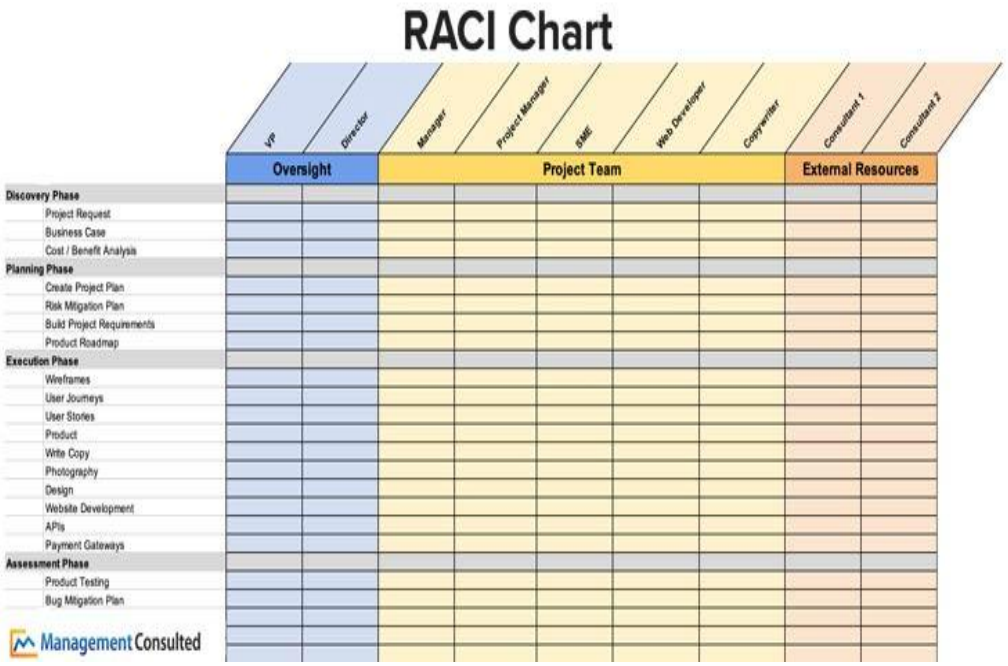
Figure 2 (System Diagram)

Team Working: Collaboration & Roles

Our team adopted an Agile-inspired design approach. Since we were not coding the final product, we focused our energy on high-quality research and user-experience design. We held weekly "Scrum" meetings to sync our progress and ensure our hardware ideas matched our software UI.

Roles and Responsibilities:

- **The Lead Researcher:** Responsible for the academic foundation. They translated the findings from the *Reddy et al.* paper into the "Needs List" that guided our design.
- **The Hardware Concept Designer:** Focused on the smartwatch. They researched sensor placement and materials, ensuring the watch would be comfortable for someone with sensory sensitivities.
- **The UI/UX Designer:** Focused on the mobile app. They designed the "Traffic Light" dashboard and mapped the user's journey to ensure the app was intuitive for stressed parents.
- **The Logic Strategist:** Developed the "Threshold Rules" (e.g., the 20% heart rate spike rule) that determined how the watch and app would communicate.



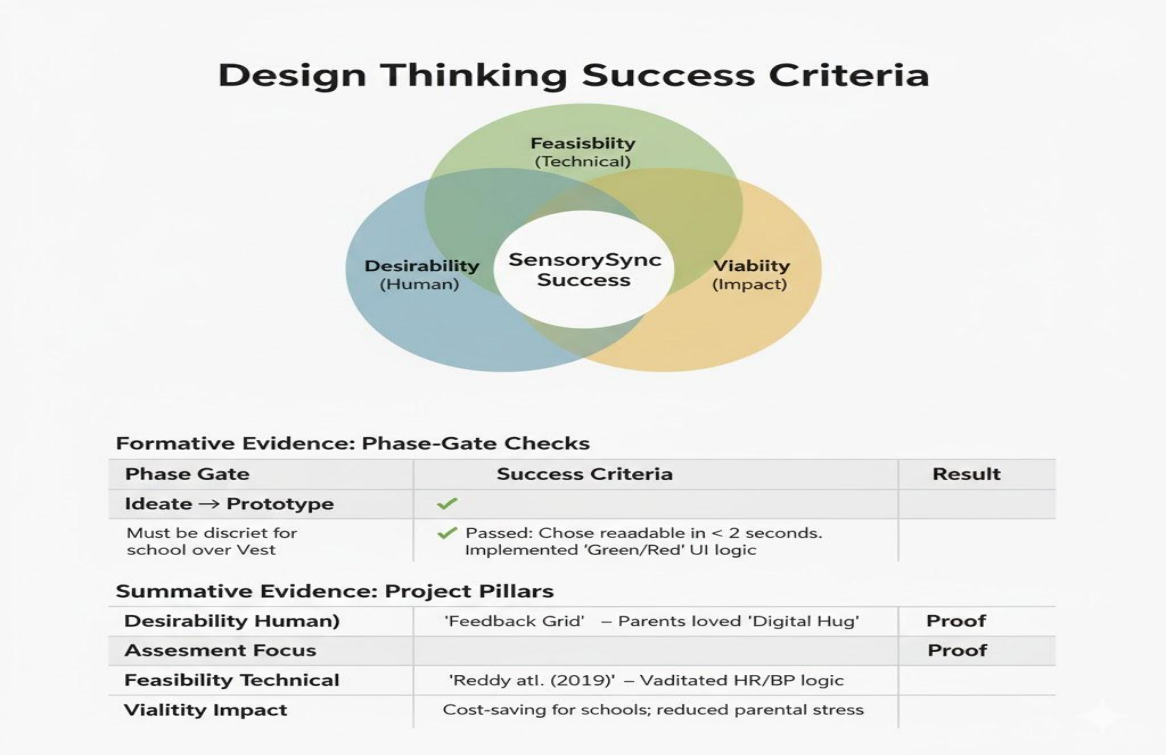
Assessment Points

To ensure the success of the **SensorySync** project, our team implemented a two-tier assessment strategy. We believe that a design is only truly successful if it is validated both *during* the creative process and *after* the final demonstration.

End-of-Project Demonstration (Summative Assessment)

The final assessment occurs during the project demonstration. Here, we evaluate the **Prototype** as a completed concept and judge its overall impact based on the three "Design Thinking Pillars":

1. **Desirability (Human):** Would a parent find the "Green/Red" status calming? Based on our testing, we found that adding the "Yellow Warning" was essential for desirability, as it reduced the anxiety of a sudden "Red" alert.
2. **Feasibility (Technical):** Is the technology (BP and Pulse sensors) realistic for a 2026 wearable? We ensured our design used sensors that are currently being integrated into modern health tech.
3. **Viability (Impact):** Does this solution bridge the communication gap for non-verbal children? The project is successful if it provides a voice to the child's physiological state when they cannot speak for themselves.



Transition Assessment (Formative Evaluation)

Assessment was not a one-time event at the end. We conducted **Phase-Gate Evaluations** during the transitions between each of the five Design Thinking stages.

- **The Logic:** At every transition, we asked: *"Does this next step still serve our original user (Adam) and solve the core problem (Sarah's hyper-vigilance)?"*
- **The Example:** When moving from **Ideate to Prototype**, we assessed our list of features against physical feasibility. We rejected the "Squeeze Vest" idea because research indicated it would be too bulky for children with sensory sensitivities. This led us to commit to the **Smartwatch** as the most practical and discreet design.
- **The Purpose:** This "gate-checking" prevented us from wasting time on high-concept ideas that did not meet the actual user needs identified in our Empathy phase.

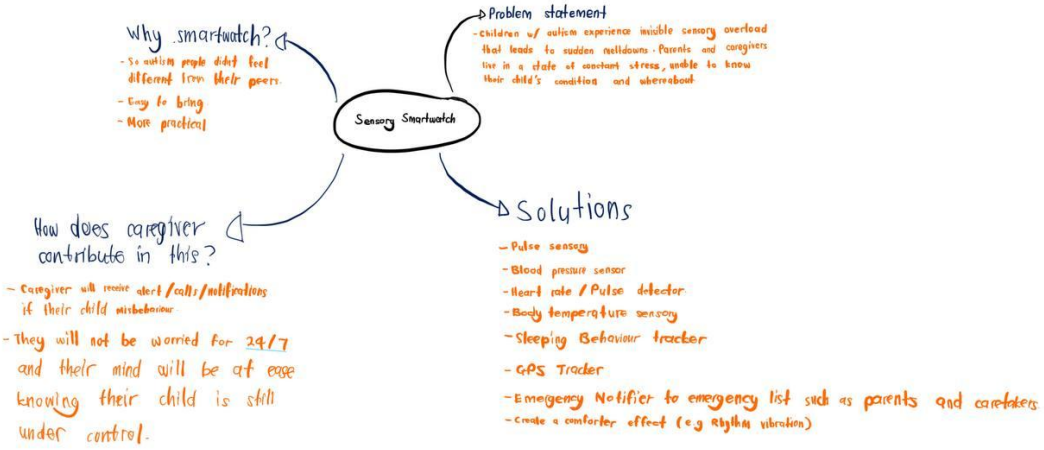
Phase Gate	Success Criteria	Result
Ideate —> Prototype	Must be discreet for school use.	**Passed:** Chose Smartwatch over Vest.
Ideate —> Prototype	Must provide objective data.	**Passed:** Selected BP and Heart Rate sensors.
Prototype —> Test	Must be readable in < 2.	**Passed:** Implemented 'Green/Red' UI logic.

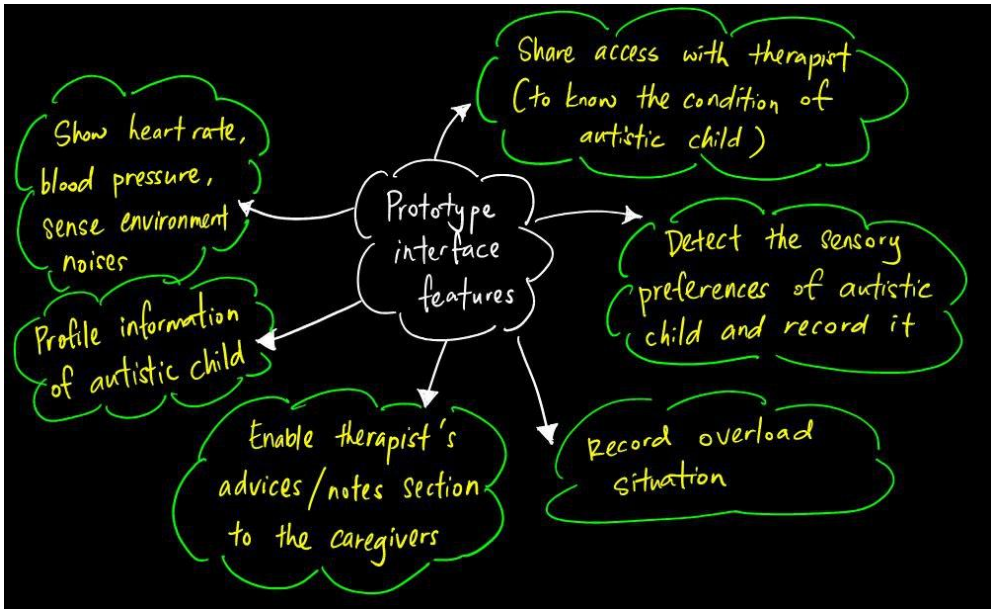
Design Thinking Evidence

Sample works to solve the design challenges:

Category 3

Real-Time Health Dashboard	A visual graph on the parent's mobile app showing live streams of Heart Rate, Pulse, and BP.
Stress History Log	A calendar view that records when and where spikes happened, helping parents identify environmental triggers (like loud music classes)
"Remote Pulse" Button.	A feature allowing the parents to manually trigger a vibration on the child's watch from their phone, letting the child know "I am here with you" even from a distance.





Records

1. Empathy

i. Purpose of empathy phase

The goal of the empathy phase is to understand the experiences, feelings, and struggles of people caring for autistic individuals. This phase focuses specifically on sensory overload, emotional distress, and communication difficulties related to sensory processing. The insights were gathered through interviews, and secondary research related to sensory issues with autism spectrum disorder (ASD).

ii. User Interviews Q&A

Interviewer: Muhammad Adlan Hud bin Ais

Interviewee: Muhammad Syahid Putra bin Salim

The interviewer asks opinion about how the public thinks about the autistic individuals and their caregivers.

Question (Adlan)	Answer (Syahid)
What are the difficulties that commonly faced by the autistic individuals in sensory?	It is really depend but a lot of them are super sensitive to their surroundings like normal to us such as bright light ,loud noise or even a crowded space which is can make them feel uncomfortable.
How do autistic individuals express when facing sensory discomfort?	A lot of times they won't just say "hey, this is too loud." It comes out in their actions. They might cover their ears, try to leave the room, get really quiet, or sometimes have a meltdown if it's too much. It's their way of coping when words don't work.

What difficulties that usually faced by caregivers?	Honestly, it's like being a detective. You have to figure out what exactly set them off, was it the sound of the fan? The smell of food? - and then try different ways to calm them down. Not every strategy works for every person, so it's a lot of trials and errors.
What kind of system would help for these problems?	I feel like something visual and simple could help a lot. Like a chart or some cards with pictures that show how they're feeling and what caregiver can do to make them feel better. If caregiver can sense their feelings earlier, overload situation might be decreased.

iii. Sample Composite character

Person 1: Parents and Caregiver

Name: Mrs. Diani

Age: 40 years old

Role: Parent and caregiver for an ASD child.

Requirement: Sensory status tracking and early warning of sensory overload.

Aim: To prevent and reduce meltdown feelings and improve daily routines.

2. Define

Based on the findings in empathy phase, we can define the problems:

CHARACTER	PROBLEMS
Caregivers (Parents)	- Difficulty to identify early signs of sensory overload
	- Reliance on late behavioural cues
	- Limited real-time information about the child's physical and environmental condition
	- Lack of timely alerts to initiate calming strategies

Hence, we can conclude that caregivers lack a systematic way of tracking sensory triggers and strategies for sensory regulation for the autistic individuals (especially child).

3. Ideate

The ideate phase aims to generate solution ideas that refer to the challenges identified in the define phase. In this project, the ideation process focused on helping **caregivers,** including parents, to identify sensory overload triggers early in autistic individuals in order to provide timely intervention.

We used several ideation ways in design thinking, such as brainstorming processes with group members, sketching to visualize the base concepts and mind mapping.

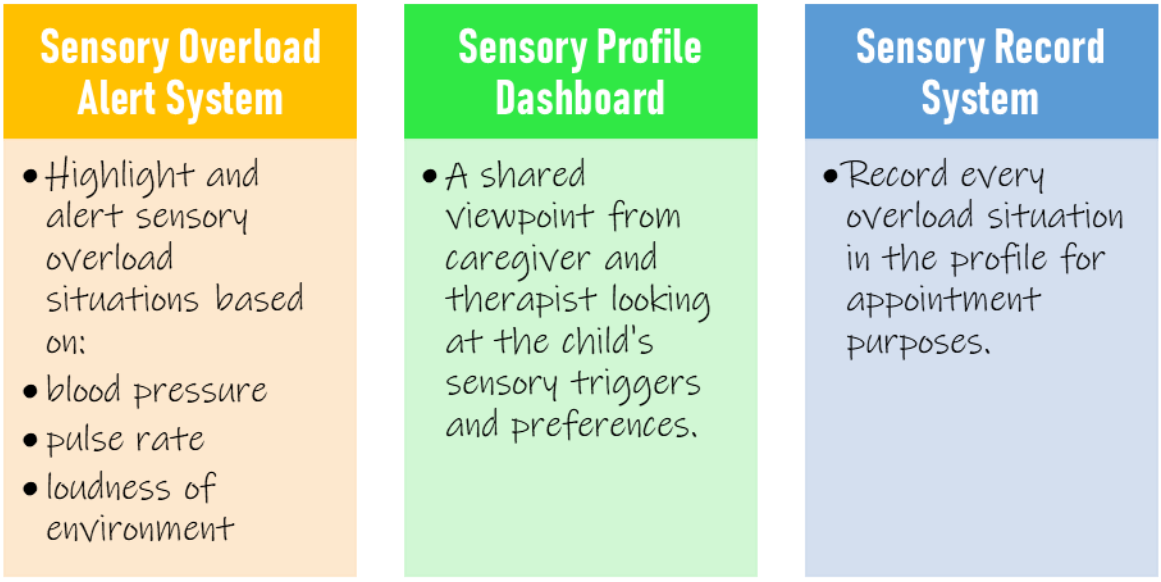
ii.Brainstorming ideas for the supporting sensory system

Brainstorming sessions aim to explore the way technology could support caregivers in monitoring sensory-related indicators. The group integrates on wearable devices, **smartwatch**, with a digital application system to improve awareness and help in early detection of sensory overload triggers.

Smartwatch-integrated sensory system:

With any of the smartwatch worn by the autistic individual, it can connect via **Bluetooth** to a caregiver's application monitoring system in their handphone interface.

The basic concepts of the application run:



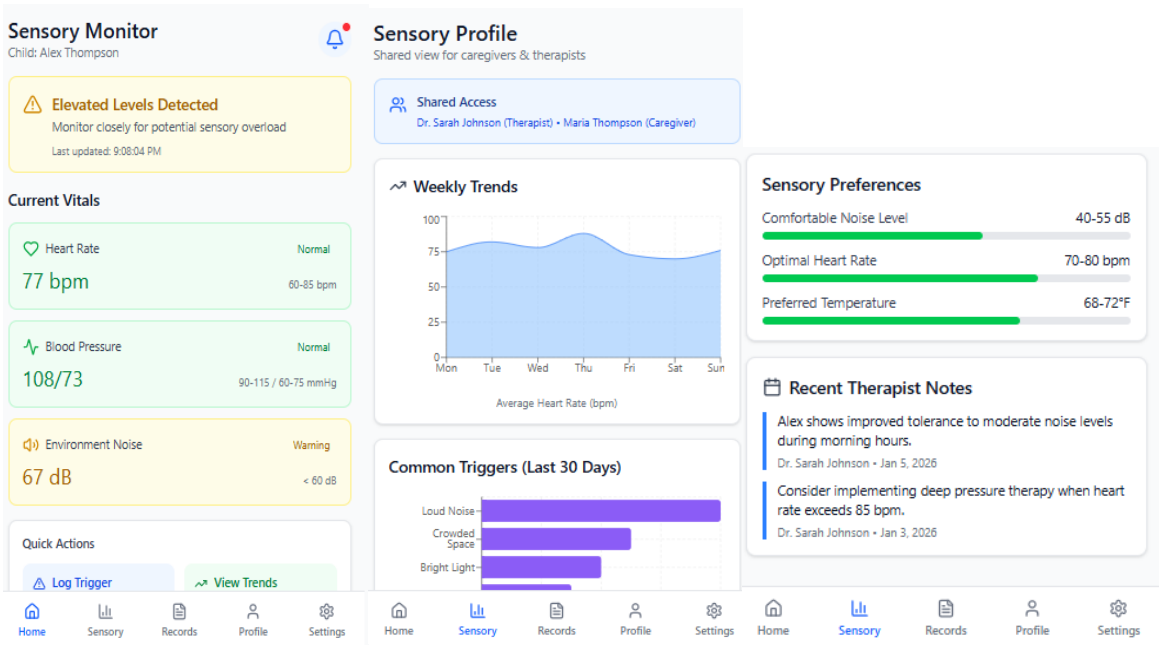
These indicators are commonly linked with stress and sensory overload. When readings exceed a predefined comfort range, the system sends a sensory alert notification to the caregiver's application.

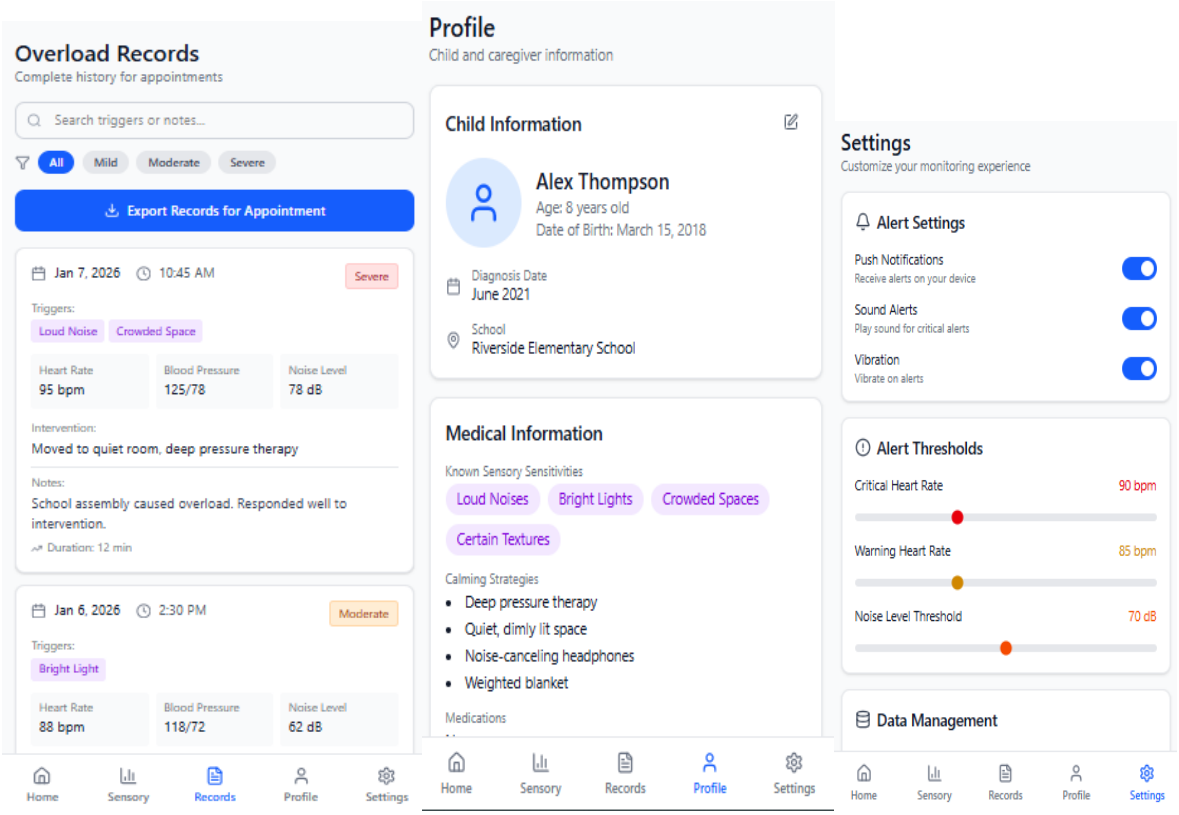
This smartwatch-application connected sensory system enables the caregivers to solve the problems:

PROBLEMS	AFTER USING THE APPLICATION SYSTEM
- **Difficulty to identify early signs of sensory overload** - **Reliance on late behavioural cues**	Receive early warnings before sensory overload escalates.
- **Limited real-time information about the child's physical and environmental condition**	Monitor the child's sensory state and environmental condition in real time.
- **Lack of timely alerts to initiate calming strategies**	Take preventive action and apply calming strategies on time, such as removing the child from overstimulating environments.

This idea focused on solving caregiver's challenges, supports early identification of sensory triggers, reduces the reliance of late behavioural cues, as well as enhances caregiver's awareness and responsibility.

4. Prototype


Sensory Monitor
Child: Alex Thompson
Elevated Levels Detected
Monitor closely for potential sensory overload
Last updated: 9:08:04 PM
Current Vitals
Heart Rate
Normal
77 bpm
60-85 bpm
Blood Pressure
Normal
108/73
90-115 / 60-75 mmHg
Environment Noise
Warning
67 dB
< 60 dB
Quick Actions
Log Trigger
View Trends
Home
Sensory
Records
Profile
Settings
Sensory Profile
Shared view for caregivers & therapists
Shared Access
Dr. Sarah Johnson (Therapist) • Maria Thompson (Caregiver)
Weekly Trends
100
75
50
25
0
Mon
Tue
Wed
Thu
Fri
Sat
Sun
Average Heart Rate (bpm)
Common Triggers (Last 30 Days)
Loud Noise
Crowded Space
Bright Light
Sensory Preferences
Comfortable Noise Level
40-55 dB
Optimal Heart Rate
70-80 bpm
Preferred Temperature
68-72°F
Recent Therapist Notes
Alex shows improved tolerance to moderate noise levels during morning hours.
Dr. Sarah Johnson • Jan 5, 2026
Consider implementing deep pressure therapy when heart rate exceeds 85 bpm.
Dr. Sarah Johnson • Jan 3, 2026


Overload Records
Complete history for appointments
Search triggers or notes...
All
Mild
Moderate
Severe
Export Records for Appointment
Jan 7, 2026
10:45 AM
Severe
Triggers:
Loud Noise
Crowded Space
Heart Rate
95 bpm
Blood Pressure
125/78
Noise Level
78 dB
Intervention:
Moved to quiet room, deep pressure therapy
Notes:
School assembly caused overload. Responded well to intervention.
Duration: 12 min
Jan 6, 2026
2:30 PM
Moderate
Triggers:
Bright Light
Heart Rate
88 bpm
Blood Pressure
118/72
Noise Level
62 dB
Home
Sensory
Records
Profile
Settings
Profile
Child and caregiver information
Child Information
Alex Thompson
Age: 8 years old
Date of Birth: March 15, 2018
Diagnosis Date
June 2021
School
Riverside Elementary School
Medical Information
Known Sensory Sensitivities
Loud Noises
Bright Lights
Crowded Spaces
Certain Textures
Calming Strategies
Deep pressure therapy
Quiet, dimly lit space
Noise-canceling headphones
Weighted blanket
Medications
Settings
Customize your monitoring experience
Alert Settings
Push Notifications
Receive alerts on your device
Sound Alerts
Play sound for critical alerts
Vibration
Vibrate on alerts
Alert Thresholds
Critical Heart Rate
90 bpm
Warning Heart Rate
85 bpm
Noise Level Threshold
70 dB
Data Management

5. Test

A volunteer was selected to participate in the testing process. The volunteer represented the caregiver user group (parent role) and had experience interacting with autistic individuals.

The testing process using guided-walkthrough method: The application interface was introduced to the volunteer, and a testing smartwatch was given to the volunteer for testing purposes.

After the linking smartwatch to application via Bluetooth, the volunteer was headed to the main screens such as sensory alert notification screen, data display of smartwatch (heart rate, blood pressure, environmental loudness), and sensory profile dashboard (notes from therapists). The volunteer was asked to explain his understanding about each interface. These details will allow the group to assess with clear, ease of use, and overall design suitability.

Feedback from the volunteer

Positive Feedback	Negative Feedback
The alert notification was clear and easy to notice. (View the overload state with colour. e.g. Red represent overload)	**Small icons cause difficulties in recognition.**
The smartwatch-linked sensory data was easy to understand.	**Lack of visual guidance like cartoon stickers on the calming suggestions makes the interfaces look boring.**
The system helped caregivers not panic to respond early to the overload situation.	**The arrangement and label for the sensory indicator features are not clear enough.**

Improvements Based on Feedback

Improvements	
	Increase the size of icons for better visibility.
	Improve the wording and add more visual elements for caregiver guidance to make it more interesting.
	Simplify the interface layout.

The testing verified that the smartwatch-linked sensory alert application concept is helpful, clear, and usable for caregivers. The feedback confirmed the design direction and provided insights for further refinement of the interface.

Reflections

Yang Kah Hin:

My goal regarding the course and program is to learn real-world problem-solving skills and technologies mastery. The skills allow me to create a useful system that enhances the quality of human life, and solves issues for communities with special needs, such as autistic individuals and ADHD individuals. During the design thinking process, it improved my ability to analyse and specify user's problems and requirements. It prepared me a vital practice for real-world solution design in the future course. The improvement that is necessary for me to improve my potential in the industry are always stay updated with the latest industry trends and technologies so that I can keep up with the times.

Soubediya Ali:

My goal in this program is to become a competent computing professional who is able to design effective technological solutions for real-world problems. The design thinking process has supported this goal by training me to focus on user needs, analyze problems systematically, and develop practical, human-centered solutions rather than only technical ones. Through the empathy and testing phases, I learned the importance of understanding users' experiences before finalizing a design. To improve my potential in the industry, I plan to continuously strengthen my technical skills, improve my communication and teamwork abilities, and gain more exposure to real-world projects that reflect industry practices.

Muhammad Adlan Hud bin Ais:

My goal for this course and the program is to acquire practical, real-world skills and become a technical expert. I hope to apply these skills to create a systems that will improve future lives especially for those in society with unique challenges, such as those with autism or ADHD. The design thinking method has improved my ability to identify user demands and precisely define problems also provided essential preparation for developing effective solutions in the future. To reach my full potential in the sector, I recognize the need to enhance my communication and collaborative skills, as effective cooperation is crucial to deliver a high-quality projects and long-term solutions.

Nik Dini Airil Adrianaa binti Nik Zainudin :

My goal is to create technology that actually helps people and makes their lives safer. Design Thinking taught me that empathy is more important than just building a working product. Working on this project showed me that even the coolest tech is useless if it doesn't solve a real human problem, like a parent's worry or a child's stress. I now see that "failing" during a test is just a great chance to fix things early. To improve, I plan to ask for user feedback much sooner, collaborate with people from different majors, and focus on making my designs simple and easy to understand.

Task For Each Member

Members	Tasks
Yang Kah Hin	• **Report (Design Thinking Evidence)** • **Lead group discussion during design thinking phase** • **Design the prototype interfaces** • **Ensure project requirements are followed**
Muhammad Adlan Hud bin Ais	• **Video** • **Interview & Conduct background research on autism spectrum disorder (ASD)** • **Analyze caregiver's need and difficulties**
Soubediya Ali	• **Video** • **Design empathy interview questions** • **Guide volunteer for prototype testing** • **Collect feedback/suggestions of improvement from volunteer**
Nik Dini Airil Adrianaa binti Nik Zainudin	• **Report (Introduction, Description & steps)** • **Documented ideas during brainstorming session** • **Evaluate and select the most suitable solution idea**