PROJECT TEAL

Accessible Symptom Tracking for Learning Disability Support

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UN SDG 10 · Reduced Inequalities

An ESP32 + Flutter assistive system translating discomfort events into data users, caregivers and clinicians can review

1 · Need discovery: start in context


3. Daily Context

Field	Notes
Date	
Time at centre	
Activities joined	
People/context observed	
Anything unusual today?	
My main focus today	

4. High-Value Observations

Time	Activity or situation	What happened?	Why it matters

5. Need Signals

Question	Notes
What did the person seem to want or need to do?	
What made it harder to do independently?	
What support was needed?	
Was this support repeated or predictable?	
Did this affect participation, confidence, safety, or staff time?	

6. Stakeholder Check

Service Users

What I learned from behaviour or simple conversation

Support Workers

Ask briefly	Notes
Is this typical?	
How often does this happen?	
What do staff usually do?	
Does this limit independence or participation?	

Caregivers, if available

Ask briefly	Notes
Does this also happen outside the centre?	
What usually helps?	
Is there one small independence goal that matters?	

7. Prototype Relevance

Question	Notes
Is the need specific enough to design for?	
Could a small software or hardware prototype realistically help?	
What type of support might be useful?	
Reminder / prompt / visual cue / sound / vibration / sensor / button / display / app / environmental change	
Would it fit into the normal routine without adding burden?	
What would make this a bad idea?	

Some Typical Questions in the Checklist

Initial work focused on understanding routines before proposing technology.

Joined normal activities first; collected evidence without disrupting routines.
Recorded barriers affecting independence, participation, confidence, safety or staff workload.
Looked for repeated, practical design opportunities rather than isolated anecdotes.
Validated observations through staff and caregiver conversations.

2 · Problem framing

Some users may struggle to recognise, remember or communicate discomfort. Important information can be lost between the moment of discomfort and later support conversations.

Discomfort occurs → **Hard to describe later** → **Information is lost** → **Less context for care**

3 · Requirements translated from observations

- Simple physical action, not long verbal recall.
- Relative intensity and duration captured during the event.
- Immediate feedback so the user knows the action was received.
- Caregiver review tools for patterns, handover and follow-up.
- Accessible day-to-day UI with more advanced settings for staff.

4 · SMART goals & LiA alignment

S	Build an accessible symptom tracker for discomfort communication.
M	Evaluate core task, BLE transfer and caregiver interpretation.
A	Use low-cost ESP32 hardware + Flutter app within placement constraints.
R	Support communication, independence and staff insight.
T	Six-week LiA; two-day testing; poster/report by 1 Oct.

UNESCO / UN SDG link: Goal 10 — Reduced Inequalities through accessible assistive technology and more equitable communication support.

5 · HOW IT WORKS : End-to-end engineering system

a. A complete hardware–software workflow: sensing → local event capture → BLE synchronisation → timeline and caregiver review.

ESP32 device
FSR pressure · duration
haptic feedback · SOS/REC
local queue · optional voice note

→ BLE GATT ←

Flutter app
Timeline · event detail
pressure curves · tags
calibration · privacy/export

Discomfort occurs →

- Press the main button: Start recording symptom immediately
- Get haptic feedback of the strength of press

→

- Press recording button to describe the symptom—the message is automatically attached to the episode

→

- Daily / Weekly Symptom Report
- More healthcare information when making diagnosis
- Build awareness of one's feelings
- Smart analysis of the course of disease

Discomfort occurs →

- App starts to log time, level and duration of the symptom

→

- Select pre-set tags in the app to easily categorize the event

Press SOS to send a message to the caregiver's phone in case of emergency

b. Technical stack

Firmware	C++ / Arduino · ESP32 BLE · I2S · SPIFFS
App	Flutter · Riverpod · Hive · fl_chart
Hardware	FSR · motor driver · SOS/REC buttons · INMP441 mic

c. Designed for two levels of use

Service user: Accessible Mode

Large text and tap targets
Home + Timeline only
2×2 action grid
4 picture tags
SOS long-press

Staff / caregiver: full toolkit

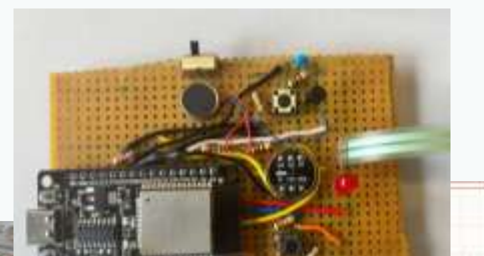
Timeline and event detail
Peak / average / duration
Pressure curve
Calibration and labels
Settings, export and privacy

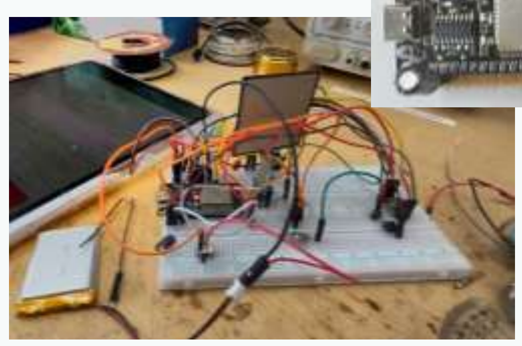
d. Core engineering decisions

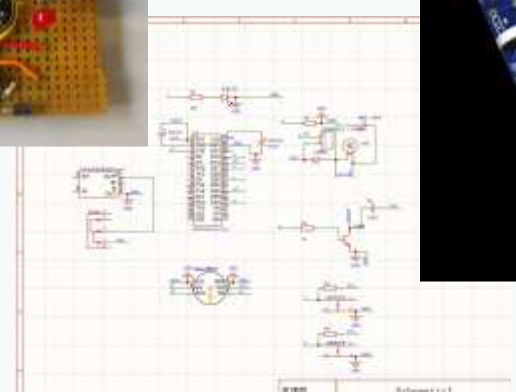
Treat the system as an end-to-end reliability problem, not just an input sensor.
Use haptic feedback to close the interaction loop for the user.
Separate accessible day-to-day interaction from caregiver configuration and review.
Keep privacy and export explicit because symptoms, voice notes and SOS location are sensitive data.

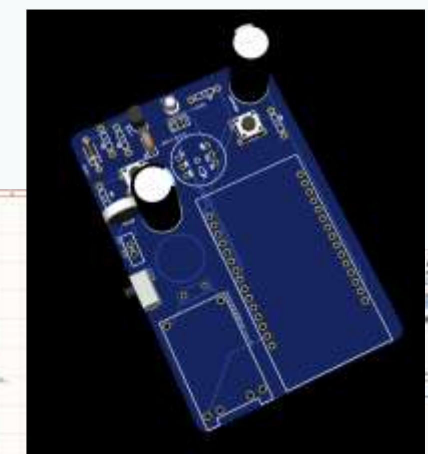
6 · Development journey: from need to prototype

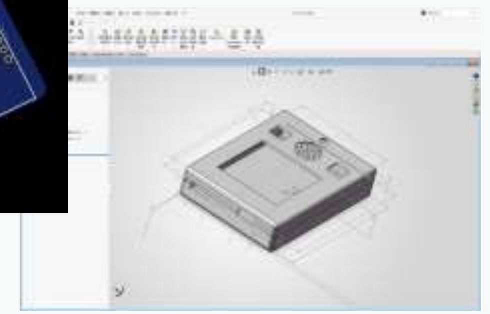
Week 1	Weeks 2–3	Weeks 4–5	Week 6
Immersion & needs discovery	ESP32 + sensing + feedback	BLE + Flutter app integration	User testing + demo + iteration











7 · Lightweight user testing & validation

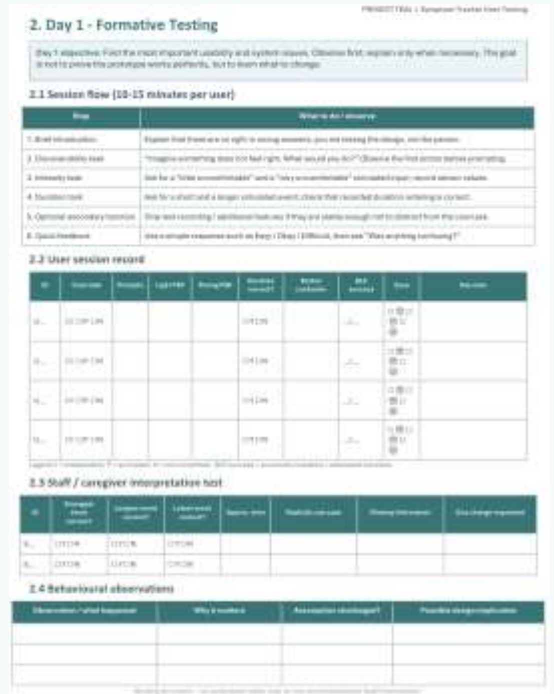
formative testing → targeted overnight iteration → confirmatory testing.
Uses simulated (imagined) discomfort only; not clinical validation; no pain or harm caused to participants

Validation questions

- Can users understand when and how to use the tracker?
- Can the device distinguish light vs strong and short vs long simulated events?
- Does the hardware-to-app BLE workflow synchronise reliably?
- Can staff interpret strongest, longest and latest event information?

100 %
test events synced via BLE

11 / 14
users complete core task with ≤1 prompt



8 · Outcomes from the LiA project

Project TEAL translated an observed communication barrier into a functional, user-informed assistive system.
Demonstrated feasibility of capturing discomfort at the moment it occurs through a simple physical interaction, rather than relying solely on retrospective verbal recall.
Integrated individual events into a longitudinal record, allowing intensity, duration and context to be reviewed over time.
User testing informed design iteration, particularly around interaction simplicity, accessibility and feedback.
Established a platform for further development, including more robust hardware, wider in-context evaluation and future deployment.

- **Key contribution:** *Connecting accessible, in-the-moment symptom input with longer-term patterns that can support communication between users and caregivers.*

9 · Engineering leadership & wider impact

Ownership: moved from an ambiguous placement brief to a working integrated system.
Adaptability: changed the problem definition as real observations challenged assumptions.
Responsible design: balanced technical ambition with accessibility, privacy, safeguarding and organisational constraints.
Potential impact: reduced reliance on retrospective verbal reporting and more equitable access to support.

Next steps: Launch TEAL Symptom Tracker on the App Store, with a patent application in progress, and continue improving the design to make it more robust.

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