SUSTAINABLE LIVING LAB

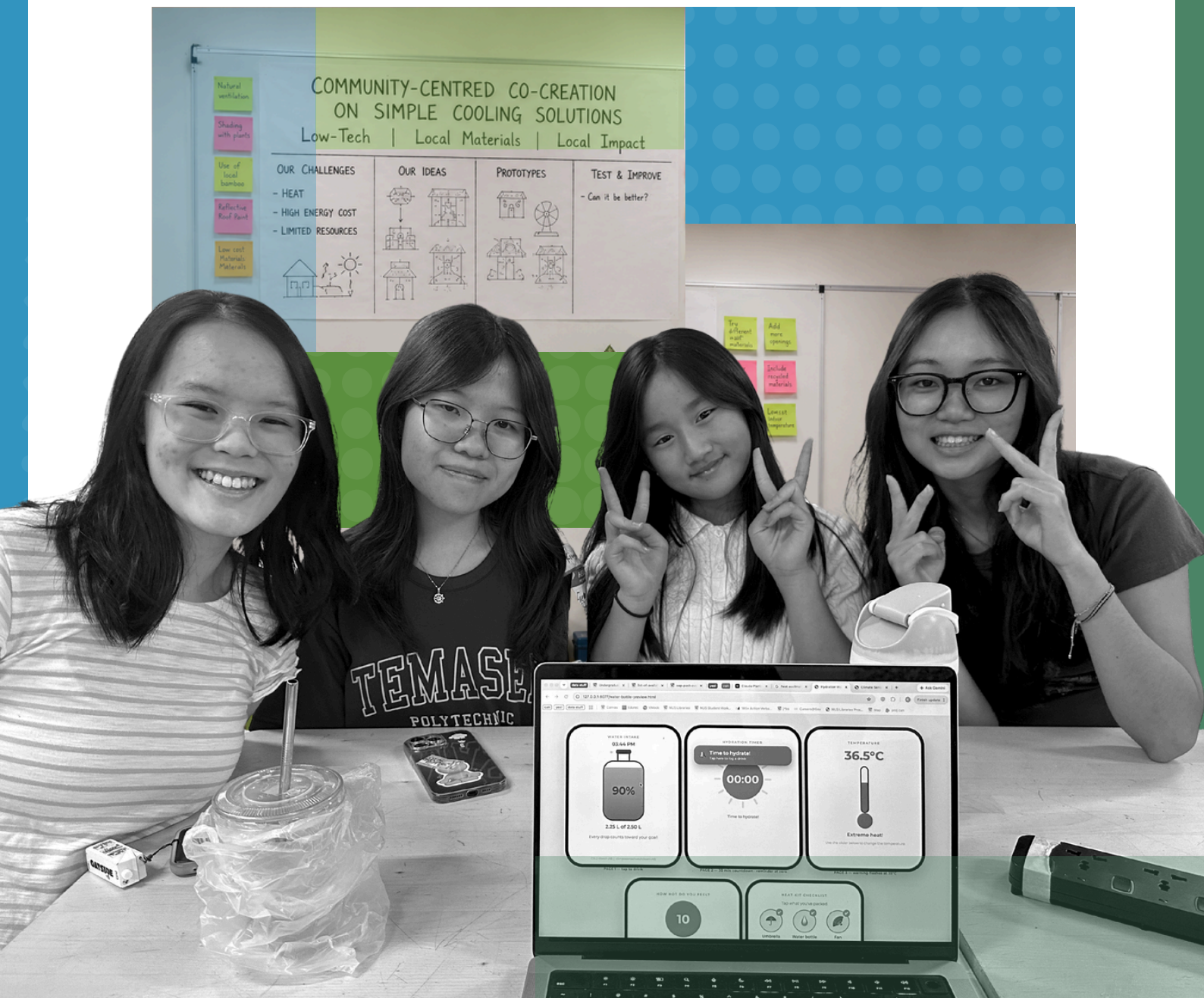
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The Climate-Sense Solutions Playbook

A community guide to designing urban heat solutions

Built from 16 prototypes created across
4 Climate-Sense Hackathons in Singapore



Section 1: Framing the Issue

Every prototype in this playbook started with a person and the moment heat became a problem for them. Before designing anything, spend time with the communities you are designing for. Learn when heat gets in their way, why it hits them harder than others, and which needs they have not yet put into words.

This section works through that framing in three steps:

- Examine how Climate-Sense arrived at its three target groups, so you can see the reasoning behind them and decide whether the same logic applies to your own users (1.1)
- Next, use feedback loops to understand why the problem persists or resolves itself, so you are designing against the actual mechanism rather than a symptom (1.2)
- Finally, the empathy questions translate that understanding into something concrete enough to sketch from (1.3)

Each step narrows the problem further, so by the end of this section you should be able to state, in one sentence, who you are designing for and what moment in their day you are intervening in.

1.1 The Three Problem Statements

Climate-Sense drew on a broader map of pre-identified heat-vulnerable groups to ground each problem statement in physiology and daily reality, rather than assumption:

- **Individuals With Chronic Conditions:** Some illnesses, and the medications used to treat them, make it harder for the body to regulate heat, narrowing the safety margin before discomfort tips into a medical event.
- **Seniors:** As the body ages, its cooling response slows. Thus, even at moderate temperatures, seniors may still be more susceptible to heat stress.
- **Expectant Mothers:** The body already works harder to stay cool during pregnancy due to foetal demands, raising the risk of both heat exhaustion and early labour.
- **Delivery Riders:** Long hours in the midday sun, with little shade and limited breaks, intensify body heat and dehydration over the course of a shift.
- **Outdoor Workers:** Sustained physical exertion in direct sun builds up internal heat, and the protective gear the job requires traps even more of it against the body.
- **Young Children:** A child’s temperature-regulation system is still immature, so their bodies can overheat far faster than an adult's.

Of these six groups, Climate-Sense selected three as the focus for its hackathon problem statements: Seniors, Delivery Riders, and Young Children.

These groups were chosen for a combination of reasons: being directly reachable through SL2's existing community networks (seniors via our affiliation with Repair Kopitiam, delivery riders via lived-experience outreach, children via caregivers and preschool-linked volunteers), and they map cleanly onto distinct, tangible daily routines such as gardening and outdoor exercise, delivery shifts, and preschool outdoor time, which a hackathon team could realistically design around within a single day.

Each of the three problem statements was then written to name the specific point of vulnerability, rather than leave it implicit:

Vulnerable Group	Why They're Vulnerable	Problem Statement
 **Seniors**	Slower cooling response with age	How might we enable seniors to enjoy gardening and outdoor exercise during warmer weather safely?
 **Delivery Riders**	Extended midday sun exposure, pay tied to volume, not time, which pushes them to rack up as many as possible (Fogarty, 2024)	How might we help delivery riders cool down between deliveries on hot days?
 **Young Children**	Immature heat regulation, high surface-area-to-mass ratio amplified by higher rates of metabolic heat production (Azan et al., 2025)	How might we redesign preschool outdoor time to build children's heat acclimatisation?

1.2 Feedback Loops

Once you have identified which group's problem you want to solve, you can consider putting it in perspective through a feedback loop, similar to what participants from Run 2 did. There are 2 types of feedback loops: **Reinforcing and balancing.**

To tell them apart, mark each link with a plus or minus sign. A **plus(+)** means both steps move the same way (more leads to more). A **minus(−)** means they move in opposite ways (more leads to less).

Reinforcing loops amplify change, so problems snowball. A loop is reinforcing if it has an even number of minus signs, including none at all.

Example:

The more time a rider spends in the heat, the more tired they get (+). The more tired they get, the fewer deliveries they complete each hour (−). The fewer deliveries they complete each hour, the longer they must work to hit their target (−). The longer they work, the more time they spend in the heat (+). With two minus signs, an even number, the loop feeds itself, and the rider's day gets worse until something breaks the chain.

Balancing loops push back against change and settle things down. These loops have an odd number of minus signs.

Example:

The hotter a rider's body gets, the hotter they feel (+). The hotter they feel, the more likely they are to stop for shade and water (+). The more they rest, the lower their body temperature falls (−). With one minus sign, an odd number, the loop corrects itself.

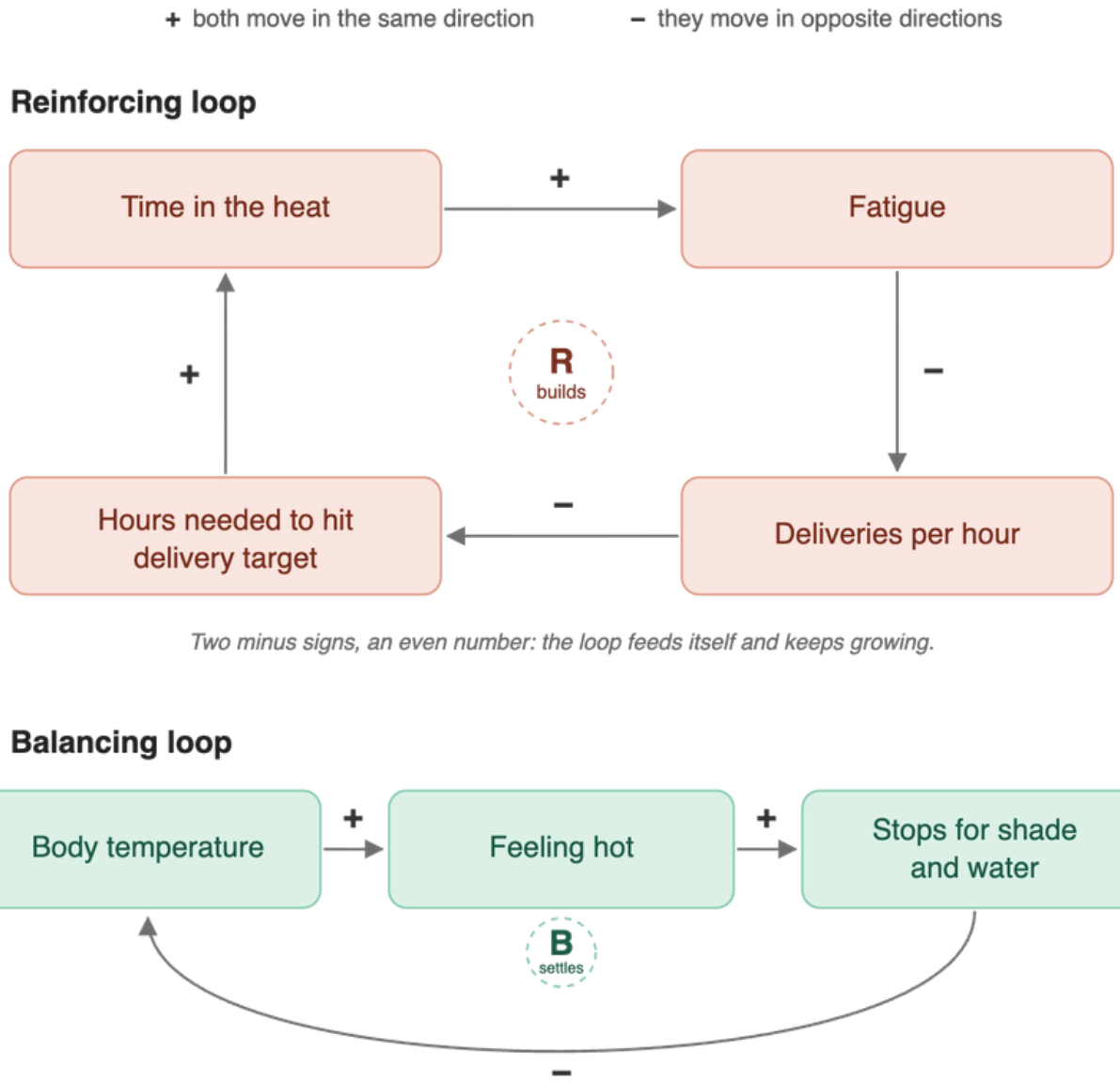


Diagram 1: Feedback Loops

1.3 Quick Empathy Questions

In your own design process, you can map out your user's day as a loop and mark the plus and minus signs. Breaking one minus-signed link in a reinforcing loop, for example adding a mandatory cool-down stop, is often more powerful than trying to fix the whole problem with a single product.

Try sorting the heat problems you or your users face into one of these two loops. Breaking a single link in a reinforcing loop is often more powerful than fixing the problem with one product alone.

- What are they doing when heat becomes a problem for them?
- Can they stop what they are doing? (Riders often cannot due to income pressure; children may not recognise danger) Is there anyone nearby who can help?
- What do they already have access to? (Existing equipment, infrastructure, employer support)
- What would they actually wear, carry, or use? (Comfort, stigma, and convenience all matter)

Section 2: Community Prototypes

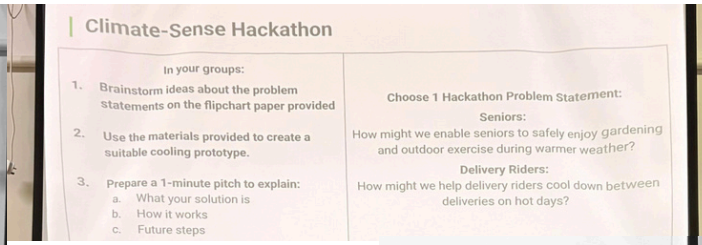
Meet the 16 prototypes that came out of four hackathons, each built in a single afternoon from low-cost, easy-access materials including, but not limited to: tape, cooling gel packs, and cardboard; and from Run 3 onwards, AI-assisted vibe-coding tools. Each prototype here is one team's answer to the problem statements and empathy questions from Section 1.

Read them not as finished products, but as 16 data points on what happens when those questions meet a single afternoon and limited materials. Section 3 regroups these same 16 by solution type if you would rather browse by approach than by user group, and Section 5 pulls out the limitations that recur across all of them.

2.1 Delivery Riders

Several teams tackled the same brief to help delivery riders cool down between deliveries on hot days, and arrived at different takes: A swappable cooling-vest network, a Peltier-cooled vest paired with a heat-aware route planner, dual cooling fans, and a passive airflow cape. Read them side by side to see which trade-offs matter most for a rider mid-shift.









DR1

Cool Wisdom

Cooling vest with gel packs swappable at a vending machine network across Singapore

Feature	Advantages	Drawbacks
Cooling packs	Effective short-term cooling, straightforward to prototype and test	May require frequent replacement
Vest structure	Skeletal design is lightweight and easy to put on over existing clothing	Users may dislike having an additional layer of clothing
Vending machine ecosystem	Complements the vest design; makes it convenient to replace cooling packs	Operating costs and the free-exchange model need a clear funding source before scaling



Front view of cooling vest



Complementary vending system ecosystem and application interface

DR2

Anti-Heat SG

Peltier-cooled water-bag vest combined with a heat-aware route planning app (A peltier is a device that uses electricity to move heat from one side to the other, creating a cool and hot side respectively)

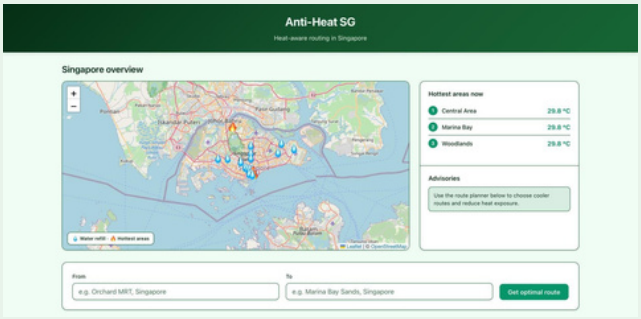
Feature	Advantages	Drawbacks
Peltier-cooled water bag	An additional water source that can provide rapid cooling	Requires a constant power source and water bag maintenance
Inner cooling packs	Portable cooling for the hand, which is one of the body parts most frequently exposed to heat	Lack of replacement methods
Route planner app	High-value feature, especially on days with extreme heat conditions	Users may disregard the results in favour of shorter routes for higher efficiency
Route planner app	High-value feature, especially on days with extreme heat conditions	



Front view of vest



Back view of vest



Route Planner showing heat/hydration spots and optimal routes.

DR3

Dual Cooling Vest

Fans at neck and back with cooling pads; lightweight, fashion-forward design

Feature	Advantages	Drawbacks
Neck and back fans	Targeted cooling of body parts that are most exposed to heat	Users may find the individual fans to be more portable instead
Cooling pack at the back	Pairs well with fans for layered cooling	Needs a clear replacement logistics plan



Front view of vest



Back view of vest

DR4

Cool Cape

Passive cape with vents that redirect airflow over gel packs as the rider moves

Feature	Advantages	Drawbacks
Vent airflow capture	Works well at high riding speeds	Difficult to engineer reliably; Effectiveness depends heavily on riding speed
Gel packs	Passive cooling that does not require power	Replacement logistics have not been factored in
Vest structure	Complete body coverage	Overhead wearing may restrict movement



Front view of the cape



Side/Back view of the cape

2.2 Children

Some of the prototypes under this category were designed around two users: the child and their caregivers. The prototypes range from a retrofitted cooling stroller and cooled bench, to wearable detectors, cooling wearable sets, and a companion app for caretakers.

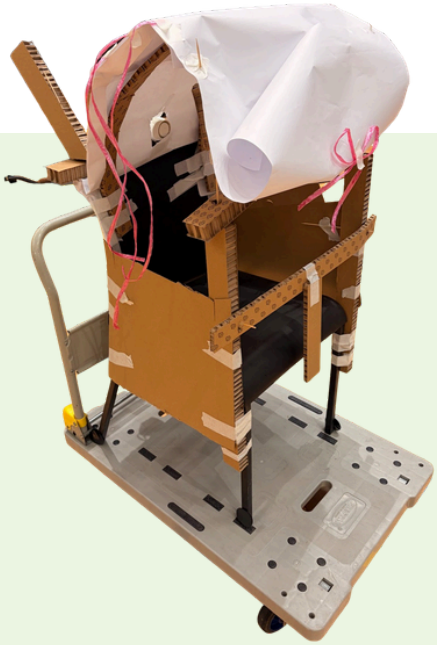


CH1

Cooling Stroller

Redesigned stroller with dual fans for child and caretaker alike, together with a cooling gel seat inside

Feature	Advantages	Drawbacks
Dual fans	Targets both users of the stroller	Power source for fan operation is undefined; Users may find clip-on fans more portable
Cooling gel seat	An additional source of comfort for a child in hot weather	Loses impact when warmed up



Side view of the cooling stroller



Back view of the cooling stroller

Cooling Wearable Set

Three-in-one: heat-dissipative shirt, slap-on wristband detector, and MagSafe-style peltier cooler (The cooler snaps on and off using magnets, similar to that of an iPhone's MagSafe charger)

Feature	Advantages	Drawbacks
Slap-on wristband	Innovative user engagement	Needs age-appropriate warnings and durable construction
Heat-dissipative shirt	Proven to be practical, functions similarly to dri-fit shirts	Dri-fit shirts may already fill this niche
MagSafe cooler	Powerful cooling tool that works rapidly; Customisation strengthens user interest	Magnet strength and power source are important issues to address



Heat-dissipative shirt prototype



MagSafe-style back cooler prototype

CH3

Heatbuster Hat

Hat with rollable shade flaps, colour-changing temperature sensor, and top-mounted cooling gel

Feature	Advantages	Drawbacks
Rollable flaps	Already exists in the market, feasible and familiar to users	Obscures vision
Colour sensor	Visual change invokes interest (and action) most effectively	Change must be visible, which is a challenge for headwear
Cooling gel at the top	Slows heat gain during outdoor activity	Frequent replacement needed outdoors; consider phase-change materials instead. (Phase-change materials refer to those that absorb heat by melting/solidifying at a set temperature, so they can cool longer than ice/gel packs)



Inner view of hat



Outer view of hat

CH4

SolaCool Bench

Peltier-cooled outdoor bench for playgrounds and rest areas

Feature	Advantages	Drawbacks
Cooled bench surface	An innovative idea that allows individuals to cool down temporarily while on the go	Requires a sustainable power source and a maintenance plan



Bottom view of the bench



Diagonal view of the entire prototype, meant to be a bus stop containing the bench

CH5

Cooling Hoodie

Colour-changing heat-sensitive vest with removable sleeves and a cooling-gel hoodie

Feature	Advantages	Drawbacks
Colour-change (thermochromic) fabric	Makes the invisible (heat change) visible	Research and development are needed to fix the colour-change temperature
Removable sleeves	Additional shade in harsh sunlight	Not much room for usage given Singapore's weather
Hoodie with cooling gel	Provides cooling and shade at the same time	Additional weight in the hoodie may impede movement



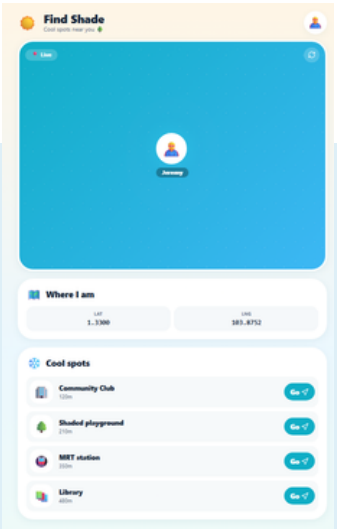
Heat-dissipative shirt prototype

CH6

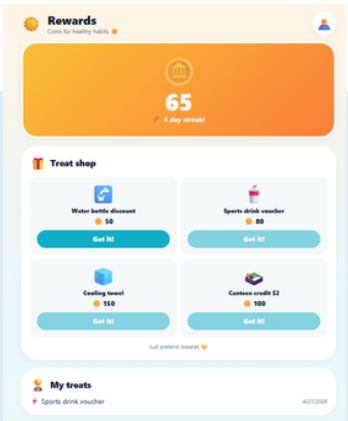
HeatSafe Kids

An application that lets parents watch their child's location and vitals live, while children earn virtual currency for staying safe in the heat.

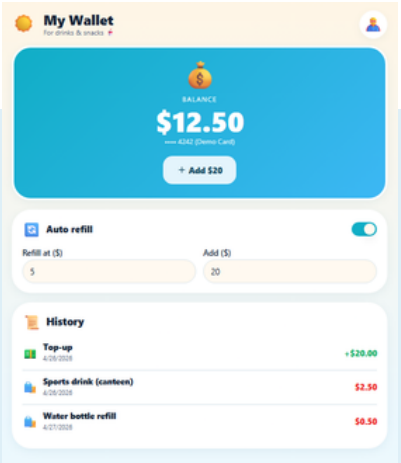
Feature	Advantages	Drawbacks
Live-time location/vital display	Parents can keep a close eye on their children's well-being and take action in time	May be concerns over risks regarding the security of location data
Virtual wallet	Children can make emergency purchases (such as hydration) if required	Lack of control mechanisms for cashflow
Virtual currency system	Gamifies heat management for children	May not be effective if available rewards are not attractive to the child



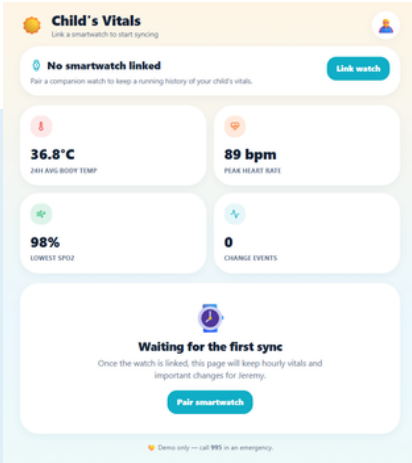
Live-time location display



Virtual currency system



Virtual wallet



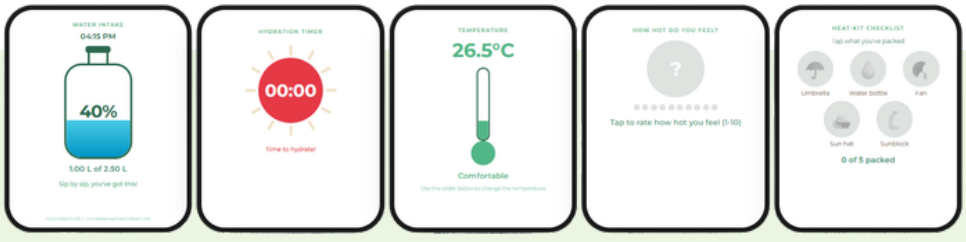
Live-time vital display

CH7

Climate Dashboard

Wearable dashboard combining hydration tracking, a temperature diagram, and a wellbeing self-assessment tool for children

Feature	Advantages	Drawbacks
Tap-based hydration tracker	Provides user with a brief oversight of water intake	Effectiveness depends heavily on users' self-discipline
Hydration reminders	Serves as a regular check-in prompting user to drink water	May be ignored by user
Live-time temperature display	Good visual representation of heat	May not be friendly towards colour-blind individuals
Wellbeing self-assessment tool	Helps user build a grasp of their own wellbeing in intense heat	Ratings are subjective, hence wellbeing ratings may be inaccurate
Heat-kit checklist	Acts as an actionable guideline for those heading out in hot weather	May be ignored by user



From left to right: Tap-based hydration tracker, hydration timer, live-time temperature display, wellbeing self-assessment tool, Heat-kit checklist

CH8

Cool Crew

Gamified wearable that turns hydration and rest habits into quests, rewards, and a simple heat index for children

Feature	Advantages	Drawbacks
Hydration minigames	Incentivises users to actively monitor their own water intake	Effectiveness decreases when users lose/lack interest in engaging
Quest list and reward store	Builds on the hydration goals and minigames to motivate users to take action that reduces heat illness risk	
Water intake tracker	Integrates the physical act of drinking with tracking	Wrist movements for other purposes may be wrongly recorded
Rest reminders	Prompts users to take breaks with justification	May be more effective if combined with a physical cue, such as vibration, to get users' attention
Heat Index Indicator *The Heat Index evaluates how heat is actually felt by combining temperature and humidity.	Simple visualisation of what the temperature feels like outside	Users may not fully grasp the implications of high temperatures



Heat index, Quest list, hydration minigames

Water intake tracker, rest reminders, reward store

2.3 Seniors

All four seniors' teams converged on the wrist and torso as the two places worth designing for.

Frosty Vest brings active and passive cooling together in one garment, while Garden-Safe, Hydration Watch and WatchFit each take a different cut at the wearable idea: hydration reminders, fall detection, and vitals tracking, so read them together to see which combination of features is worth carrying forward, and which risks are unnecessary.



S1

Frosty Vest

Detachable waterproof vest with Peltier active cooling, cooling strips, packs, and a sun-blocking hoodie

Feature	Advantages	Drawbacks
Waterproof	Fit for multi–weather usage	Counterproductive in heat
Peltier at the back	Rapid, powerful cooling	Power source is critical
Cooling strips and packs	A combination of passive and active cooling to ensure consistent action	Location only at the top and bottom is suboptimal as most heat gain is at the torso centre
Hoodie	Gives users the option to block out harsh sunlight if they have to work outdoors	May obstruct sweat evaporation from the neck





Front and back view of vest



Inner view of vest

S2

Garden-Safe

Senior wellness wearable with hydration reminders, a fall detector, and customisable alerts

Feature	Advantages	Drawbacks
Hydration reminders	Encourages users to stay hydrated during outdoor activity	Effectiveness heavily depends on the individual's self-discipline to hydrate when reminded
In-built fall detector	Can quickly flag falls so help can be sought	Sudden motion can also set off false alarms
Customisable settings (temperature units, alarms)	Personalises experiences for users	Users may not engage with this feature effectively due to a lack of understanding or interest



Hydration tracker



Watch interface

S3

Hydration Watch

Senior wearable with time-based hydration reminders, a heat-colour display, and AI voice alerts

Feature	Advantages	Drawbacks
Hydration reminders based on time of day	Provides regular prompts to drink water	Effectiveness may be impeded if users choose to ignore the reminders
Coloured borders based on environmental temperature	A straightforward visual representation of surrounding heat	May pose accessibility issues for colourblind individuals
AI voiceover	Alternative way to transmit information for those who may not like having to check the wearable regularly	May not be as effective for individuals with hearing issues
Emergency alerts for poor health	Good for alerting users about potential risks	There is a risk of false or delayed alerts



Watch face showing hydration reminder

S4

WatchFit

Senior fitness wearable tracking vitals, hydration, body temperature, and sleep/stress

Feature	Advantages	Drawbacks
Step / heart rate / blood oxygen tracker	Provides continuous vitals monitoring	Considered a norm for wearables nowadays
Water intake tracker	Encourages hydration awareness	Requires active input from the user
Body temperature tracker	May prove useful in hot weather	Proxy estimate of core body temperature may not be the most reliable or accurate
Stress level / sleep score tracker	May provide insight for overnight rest in hot weather	Readings may be inaccurate after workouts as physiological symptoms are measured to calculate stress



Overview of steps taken as well as water/calorie intake ; Step goal ; Water intake goal

Section 3: The Solution Menu

Section 2 organised the 16 prototypes by ***who*** they were built for. This section reorganises the same prototypes by ***what kind*** of solution they are: Wearables, digital tools, infrastructure, policy, or behaviour change, so you can browse by the type of intervention you are able to build, regardless of which user group you are designing for.

If you already know you want to build something worn on the body, or something purely digital, or something that changes an environment rather than a habit, start here instead of Section 2. Each category shares “strengths/watch-outs” to help you judge whether that solution type fits your constraints before you commit to it.

Most items below come from the 16 hackathon prototypes in Section 2. A few, including Water Dispensers & Open Pantries in 3.3, and all of 3.4 (Policy) and 3.5 (Behaviour Change), are broader ideas the teams' work pointed toward, not standalone prototypes from the hackathons.

3.1 Wearables & Personal Gear

10 of the 16 prototypes took the form of something worn on the body: Heat is a personal, physical problem. Below is the full spectrum, from zero-power passive options to fully active cooling.



1 Passive Cooling Vests / Capes

No power needed. Rely on gel packs or phase-change materials that absorb heat from the body.

Strengths	Watch-outs
• Low weight when the gel is fresh	• The gel needs replacement when it warms up
• No power source needed	• Replacement logistics are a major design challenge
• Can be made cheaply with off-the-shelf materials	• Added weight may deter potential users

2 Active Cooling Vests (Peltiers / Fans)

Powered cooling using thermoelectric peltier modules or fans directed at the torso or neck.

Strengths	Watch-outs
• Continuous, adjustable, rapid cooling	• Power source is critical for battery life, weight and recharging functions
	• Higher cost and maintenance than passive options

3 Headwear

No power needed. Rely on gel packs or phase-change materials that absorb heat from the body.

Strengths	Watch-outs
• The head is a hotspot for heat accumulation - solution impacts may be more prominent.	• Children and seniors may not always be inclined to wear a hat
• Shade is a guaranteed function	

4 Smart Wristbands / Wearable Sensors

Detect real-time skin or ambient temperature and alert the wearer or caretaker to seek shade or hydrate.

Strengths	Watch-outs
• Portable	• Young children may not understand warnings
• Alerts are more likely to be visible	• Durability must withstand running, falling, and water
• Can be personalised and fun for kids	• Needs charging; data privacy considerations for children

5 Heat-Responsive Clothing

Colour-changing fabric that turns red when the temperature rises, making heat visible and teaches body awareness.

Strengths	Watch-outs
• No electronics or batteries needed	• Mechanism for reliable colour-change needs validation
• Design encourages engagement stemming from curiosity	

6 Caregiver-Carried Cooling Gear

Equipment the caregiver pushes or carries rather than wears, e.g. a stroller retrofitted with fans and a cooling gel seat.

Strengths	Watch-outs
• Cools both child and caregiver at once	• Power source for fans is often undefined
• No garment weight on the child	• Bulkier than wearable alternatives

3.2 Digital Tools & Apps

Not every solution needs cooling elements. Some of Climate-Sense's prototypes were software: Apps and dashboards that complement a physical product, or that work as standalone planning and awareness tools in their own right.

1 Heat-Aware Route Planner

Plots travel routes that avoid hotspots.

Strengths	Watch-outs
• Easy to use. • Actively reduces heat exposure rather than just monitoring it.	• Riders prioritise delivery speed over comfort, so this needs to be frictionless to adopt.



2 HeatSafe Kids

Shows parents their child's live location and vital signs so they can step in before heat becomes dangerous.

Strengths	Watch-outs
• Gives parents real-time visibility on their children's location and vitals, so they can step in quickly if something looks wrong.	• The location feature may raise data privacy concerns among users, especially when it involves children.
• Virtual currency/wallet adds an additional engaging layer to the tool.	

3 Climate Dashboard

Allows parents to help their children manage heat stress.

Strengths	Watch-outs
• Bundles hydration tracking, live-time heat displays and a self-assessment tool into one interface, making heat-risk awareness a daily habit instead of a one-off warning.	• Novelty may wear off, which leads to a drop in engagement.

3.3 Infrastructure & Environment

The categories so far put the work of cooling down on the individual: Wearing a vest, checking a phone. This category flips that. These solutions modify the shared environment so that heat is reduced before it reaches a person, so no behaviour change is required.

1 Cooled Public Furniture

Cooled benches or surfaces at bus stops, playgrounds, or rest zones for riders.

Strengths	Watch-outs
• Serves everyone who uses the space, so no behaviour change is needed	• Power supply is a significant infrastructure cost
• Reduces heat buildup temporarily for individuals on the go	• Cooling devices may need replacement, which creates an ongoing maintenance burden
• Could be solar-powered to reduce running costs	• Does not help people on the move as they are limited to fixed locations

2 Vending Machine Ecosystem

Network of vending machines where riders can swap used cooling packs for fresh ones.

Strengths	Watch-outs
• Solves the replacement logistics problem for gel packs	• High operating cost for refrigeration, restocking and maintenance
• Potential app integration for location mapping and mobile payment	• Needs investment in enabling infrastructure / scaling up
• Scalable if subsidised or sponsored	• The free cooling pack exchange model requires a sustainable funding source





3 Water Dispensers & Open Pantries

More water refill points and free pantries for riders at hubs, hawker centres, or petrol stations.

Strengths	Watch-outs
• Very low-cost to pilot	• Requires business or community buy-in
• Riders and seniors already stop at these locations	• Maintenance and hygiene management needed
• Hydration is foundational to heat safety	• Does not address heat during the journey itself



3.4 Policy & Systemic Changes

Rules put people in risky situations: a bus stop with no shade, a shift with no water break. Changing those rules protects everyone at once. A one-day hackathon may be too short to build that kind of change, so no team aimed for it directly. Still, several teams mentioned during the group's sharing that their physical solution was really pointing toward a policy change. Here are some examples:

- **Mandatory rest periods** for delivery riders during peak heat hours, such as 12pm - 3pm
- **Platform algorithm adjustments** to reduce clustering of deliveries in heatwave conditions.
- **Preschool outdoor schedule redesign:** Move outdoor play to 8-9am and 4-5pm slots.
- **Heat acclimatisation curriculum:** Structured, gradual exposure to build children's tolerance over time
- **Employer-provided cooling gear** as part of occupational safety requirements
- **Community centre partnerships** to open as cooling shelters during peak heat hours

Limitations to Acknowledge

- **Policy changes take time and face resistance from platforms, schools, and employers.** Start small and local. One school, one team, or one family can adopt a rule this week. These pilots move faster than national policy and become proof that the idea works.
- **Enforcement is difficult without monitoring infrastructure.** Build shared habits instead. When a group agrees on a rule together, like phones in a basket during class or no work messages after 7 pm, people hold each other accountable without any monitoring system.
- **Policies rarely solve the immediate, acute problem; they are always combined with physical or digital solutions.** Pair every rule with a simple tool. Most phones and laptops already have focus modes, app limits, and quiet hours. Policy sets the goal; these tools make it easy to follow today.



3.5 Behaviour Change & Education

The Heat Health Masterclass that opens every Climate-Sense hackathon is itself a behaviour-change intervention, and its impact showed up in what participants built afterward. Use the ideas below to help the people around you understand heat risk and change how they act, before they ever need a product to bail them out.

- **Gamified heat education:** Cartoon characters warn children when temperature spikes, and interactive activities feature rewards to turn heat awareness into intrinsic motivation
- **Colour-change feedback loops:** Make the invisible (body heat) visible through responsive materials
- **Caretaker training:** Educate teachers and parents on early signs of heat stress in children
- **Rider peer networks:** Share cooling tips, break spots, and gear reviews within delivery communities.

Section 4: Prototyping Tips & Tricks

You have now seen who is vulnerable, what has already been tried, and the wider menu of options. This section lists the same tools used by Climate-Sense participants to go from a blank flipchart to a working prototype and a one-minute pitch, all within a single afternoon, the same process you will use in the brainstorm canvas in Section 6.

4.1 Brainstorming

Use structured prompts to generate ideas before filtering. For instance, try these:

- What does the person do right before they feel too hot? What if you intervened there?
- What does 'cooling down' mean for this user: Body temperature, comfort, safety, or mood?
- What resources does this user already have? (A vehicle, a phone, a uniform, a school bag)
- Who else is in the system: Employer, platform, school, caretaker, government? Can they do the work instead?
- What is the cheapest possible version of this idea? What is the most ambitious version?

4.2 The Micro-Macro Stack

Generate solutions at each level, then ask which levels reinforce each other.

Feature	Advantages	Drawbacks
Micro (individual)	Provides continuous vitals monitoring	Considered a norm for wearables nowadays
Meso (immediate environment)	The space or community around them	Shaded rest spot, cooled bench, water dispenser
Macro (system/policy)	Rules, platforms, infrastructure, norms	Delivery scheduling, school curriculum, and vending network

4.3 Three Lenses

Ideas can be sorted into one of three intervention types. Use all three when brainstorming, then pick where to focus.

Lens	What it means	Example from prototypes
Detective	Monitor conditions and alert people before harm occurs	The Cooling Wearable Set features a wristband that detects real-time skin temperature and issues voice warnings
Preventive	Stop heat from building up in the first place	Anti-Heat SG app routes riders away from hotspots; Heatbuster hat blocks sunlight with rollable flaps
Corrective	Cool the person down after heat exposure has occurred	Cool Wisdom cooling vest with gel packs; SolaCool cooled bench surface



4.4 Defining Success

Decide on something you want to achieve with your prototype before beginning construction. In the context of heat, here are some quantifiers to start you off:

Physiological	Lowered core body/skin temperature
Behavioural	Regular usage in daily life
Safety	Reduction in heat-related incidents reported by users or their employers
Comfort	Self-reported comfort score; qualitative feedback from users
Economic	Cost per user per month; willingness to pay; cost versus current alternatives

4.5 Rapid Prototyping on a Budget

Low-cost materials can prove to be quite useful for prototyping. See some listed below:

Vest structure	Plastic bags and tape as a wearable chassis
Cooling elements	Gel ice packs from convenience stores as cooling inserts
Active cooling	Small USB fans clipped onto the card or plastic frames
Heat sensing	Thermochromic (materials which change colour in response to temperature) paper or paint for colour-change demonstrations
Infrastructure	Cardboard and cable ties for structural frames
Digital interfaces	Paper mockups or slides for app screens
Electronic placement	Modelling clay or foam for peltier or sensor placement

Section 5: Common Limitations to Design Around

Every prototype in Section 2 ran into at least one of the five limitations below; some solved it, most did not fully. Treat this less as a warning list and more as a pre-mortem: Understand the 5 below before you finalise your Top 3 in Section 6, so you are designing around a known failure mode instead of discovering it after you have built something.

5.1 The Replacement Problem

Almost every passive cooling approach hits the same wall: the cool runs out. Before finalising your design, decide:

- How often does the cooling element need to be replaced or recharged?
- Can the user do this themselves, or do they need external infrastructure?
- Is replacement free, subsidised, or paid? Does that model hold at scale?
- What does the user do in the gap between packs running out and getting a fresh one?

Design Strategies for the Replacement Problem

- Phase-change materials (PCMs) that recharge passively in shade or air-conditioned spaces
- Modular inserts small enough to carry a spare, similar to spare batteries
- Combine passive cooling with active (fan) so one element continues when the other is exhausted
- Design for 'good enough': Even partial cooling reduces risk meaningfully

5.2 The Adoption Problem

Here are some factors that reduce adoption:

Weight	Every extra gram matters for riders carrying food boxes; caretakers pushing strollers
Stigma	Riders may not want to stand out with an unusual vest; children may refuse unfamiliar gear
Comfort	Tight fits, sweaty materials, or fan noise reduce tolerance over a long shift
Interest	Novelty is a major pushing factor behind gamification, which can slowly lose appeal over time

Design Strategies for the Adoption Problem

- Design for existing habits: Attach to equipment riders already carry (delivery bags, helmets)
- Consider user preferences: Riders want to avoid flashy designs, while children may be attracted to them.
- Minimise effort: One-click exchanges, auto-notifications, ambient sensing with no user action
- Co-design with users: Sessions with your target audience can reveal relevant struggles
- Constant refreshment: Regular updates to rewards can help to retain interest



5.3 The Power Problem

Active cooling is effective but power-hungry:

- Peltier modules are energy-intensive: They can put more strain on a motorcycle or e-bike battery
- USB-powered fans have limited battery life and must be recharged, adding a daily maintenance step
- Solar panels on vests work in principle, but add weight, cost, and failure points
- Power to cool benches requires consultation with urban infrastructure teams

Design Strategies for the Power Problem

- Default to passive options (gel packs, phase-change materials) wherever they meet the cooling need, and reserve active components (Peltier, fans) for cases where passive alone isn't enough
- Duty-cycle active elements, short bursts of Peltier/fan operation instead of continuous run, to stretch battery life without losing effectiveness
- Tap into power sources riders and infrastructure already have: e-bike/motorcycle batteries, vending-machine docking points, or existing lamp-post/bus-stop wiring for benche
- Build in a "low-power fallback" so the product still offers partial cooling (e.g. passive gel) once battery-powered elements die
- Loop in infrastructure owners (town councils, LTA) early for anything needing fixed power, this is a partnership problem as much as an engineering one

5.4 The Scale Problem

What works for a prototype may not work when deployed for hundreds or thousands of users:

- A single vending machine is easy to stock; a network across Singapore requires logistics and ongoing funding
- A custom app works for a demo; a production version requires maintenance, security, and API integration
- A hand-sewn vest is great for testing fit; manufacturing at scale requires supply chains and quality control

Design Strategies for the Scale Problem

- Pilot with a small, contained cohort first (one delivery hub, one estate) and instrument usage before committing to island-wide rollout
- Favour distribution models that piggyback on existing networks (retail, vending, transit) over building new infrastructure from scratch
- Treat apps as production software from day one: Plan for maintenance, security patching, and API costs, not just the demo build
- Design for manufacturability early: standard components and modular parts make quality control at volume far easier than one-off hand-built prototypes
- Settle the funding/ownership model before scaling: Grant-funded pilot, self-sustaining fee model, or subsidised public service each imply very different designs

5.5 Singapore-Specific Considerations

- High humidity means sweat does not evaporate as rapidly, hence evaporative cooling is less impactful than in dry climates
- Designs must be able to handle heat and wet conditions due to erratic weather
- Dense urban infrastructure is both a constraint (contributing to the Urban Heat Island effect) and an asset (proximity to cooling spaces and transit)

Design Strategies for the Scale Problem

- Weight active cooling (fans, Peltier, phase-change materials) over pure evaporative approaches, since Singapore's humidity limits how well sweat-based cooling works
- Choose materials that perform in both heat and sudden rain: Quick-dry, water-resistant fabrics rather than heat-only solutions
- Route-planning and hotspot tools should account for Urban Heat Island zones (exposed pavements, construction sites, low-shade stretches), not just raw temperature
- Design to connect with, not duplicate, Singapore's existing cooling infrastructure, MRT stations, malls, void decks, etc. as waypoints rather than building standalone shelters

Section 6: Your Brainstorm Canvas

This is where the playbook stops being something you read and starts being something you fill in. Print or copy this canvas and work through it with your team before getting down to business.

Feature	Advantages
Our problem statement	How might we...
Who are we designing for?	Describe the person, their day, and when heat becomes a problem for them.
What resources do they already have?	Phone, vehicle, clothing, access to shops or CCs, employer support...
What can they NOT control?	Schedule, income pressure, weather, employer requirements...
Which lens(es)?	Detective / Preventive / Corrective (circle all that apply)
Which scale(s)?	Micro (personal) / Meso (environment) / Macro (system)

6.1 Idea Dump

Wearable / Personal	Digital / App	Infrastructure / Policy

6.2 Filter Your Top 3 Ideas

Idea	Power source?	Replacement plan?	Will they adopt it?	Who funds scale?
1				
2				
3				

6.3 Build Plan

Area	Notes
What we will build	
Materials needed	
Who does what	
How we will test it	
What good looks like	

Section 7: Going Further

The 16 prototypes in this playbook were each built in a single day by one team working alone. Real, lasting impact tends to come from stacking several of these ideas together, leveraging on new and upcoming technologies, and bringing in partners who can carry a prototype further than a hackathon table ever could. This closing section covers all three.

7.1 Combining Solutions

Multiple solution types can be combined for a magnified effect. Here are three example combinations:

Rider Combination Example	Children's Combination Example	Seniors Combination Example
Vest (passive cooling packs) + App (route planner + vending locator) + Policy (mandatory break zones at hawker centres)	Wristband sensor (detect and alert) + Scheduled acclimatisation play (behaviour) + Shaded cooled benches at playground (environment)	Lightweight cooling vest (passive) + Community buddy programme (social) + Town council heat-adjusted scheduling (policy)
Each element addresses a different failure mode: the vest handles in-motion cooling; the app helps plan breaks; policy ensures rest is structurally supported.	The sensor catches acute risk; the schedule builds long-term resilience; the bench provides a recovery point.	Addresses physical, social isolation, and structural risk factors simultaneously.

7.2 Technologies Worth Exploring

Multiple solution types can be combined for a magnified effect. Here are some examples of technologies that you can explore to tackle the issue of heat stress:

Phase-change materials (PCMs)	Wax or salt compounds that absorb heat at a set temperature are longer-lasting than gel packs and can recharge passively
Thermochromic dyes	Already used in novelty products; becoming more reliable for functional heat-warning applications
Peltier modules	Widely available and affordable; the key engineering challenge is power efficiency
Bluetooth Low Energy (BLE) sensors	Under SGD 10 temperature and humidity sensors that pair with smartphones
Solar textiles	Thin-film solar cells integrated into fabric are at early stages of exploration, but seem promising for outdoor wearables
Evaporative cooling membranes	Materials that enhance sweat evaporation are less effective in Singapore's humidity but worth testing in drier contexts

7.3 Who Can Be Partnered With

The robustness of a solution can be enhanced by effective partnerships. Here are some examples of organisations or entities that can act as potential partners and what they bring to the table:

Entity	What they bring
Delivery platforms (Grab, Foodpanda)	Access to the rider community for testing; potential to mandate gear or build cooling into the app experience
Preschools and the Ministry of Education (MOE)	Testbed for children's solutions; ability to change schedules and integrate into the curriculum
Government organisations such as the National Environment Agency (NEA) and the National Parks Board (NParks)	Data on hot zones; infrastructure for public cooling; grant funding for pilots
Health Promotion Board	Behaviour change expertise; hydration and heat awareness campaigns at scale
Community Centres / the People's Association (PA)	Physical space for cooling shelters; direct reach into senior communities
Local makerspaces	Rapid prototyping support; electronics and materials expertise
Materials suppliers	PCMs, thermochromic dyes, and UV-protective fabrics at small-batch quantities for prototyping

Section 8: References (APA)

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