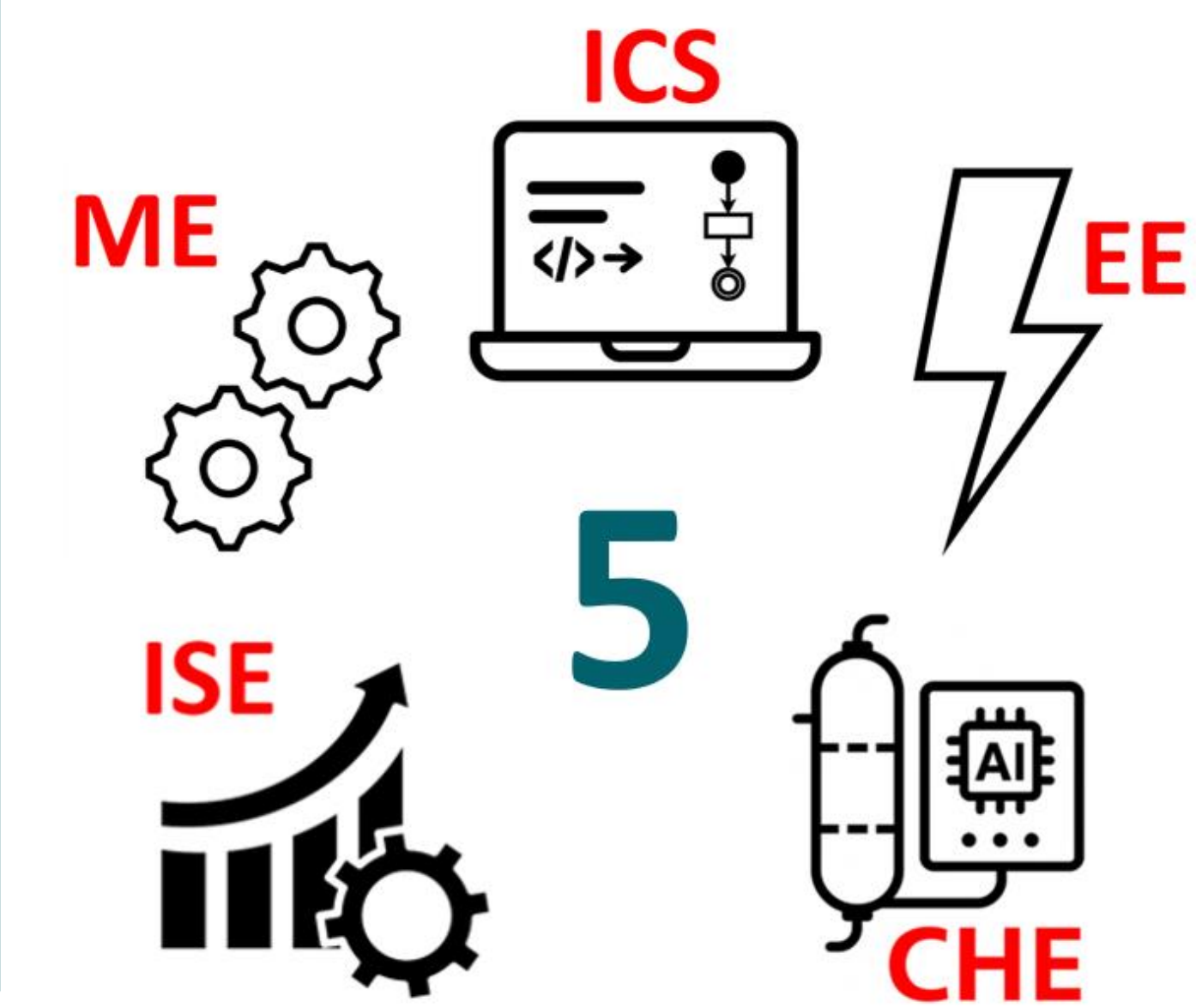


Solar-Powered Hajj Umbrella with Group Tracking, Safety Features, and Cooling Mechanism

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Background

Hajj involves extreme heat, long walking distances, and dense crowds, creating serious risks and contributing to at least 1,300 deaths in 2024. Vulnerable groups face even greater danger, while crowding increases the likelihood of getting lost and delays in emergency response. Existing solutions are fragmented and impractical, as pilgrims cannot easily manage multiple devices such as an umbrella, a fan, and a mobile that depends on Wi-Fi for navigation.

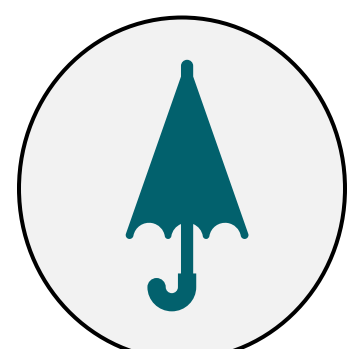
Problem Statement

The Smart Hajj Umbrella is a portable, integrated solution designed to reduce heat-related risks and enhance pilgrim safety through accessible, real-time assistance during Hajj and Umrah.

Constrains



1. Safety & Protection: Enclosed wiring, no short-circuit risk, IP65 water-resistant (rain-safe)



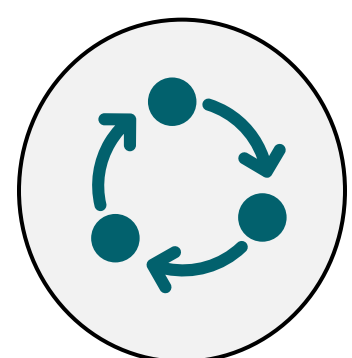
2. Compact Design: Lightweight, foldable within ≤ 15 cm diameter for portability



3. Thermal Performance: Reliable and safe operation in temperatures up to 50°C



4. Privacy & Compliance: PDPL + CST compliant tracking



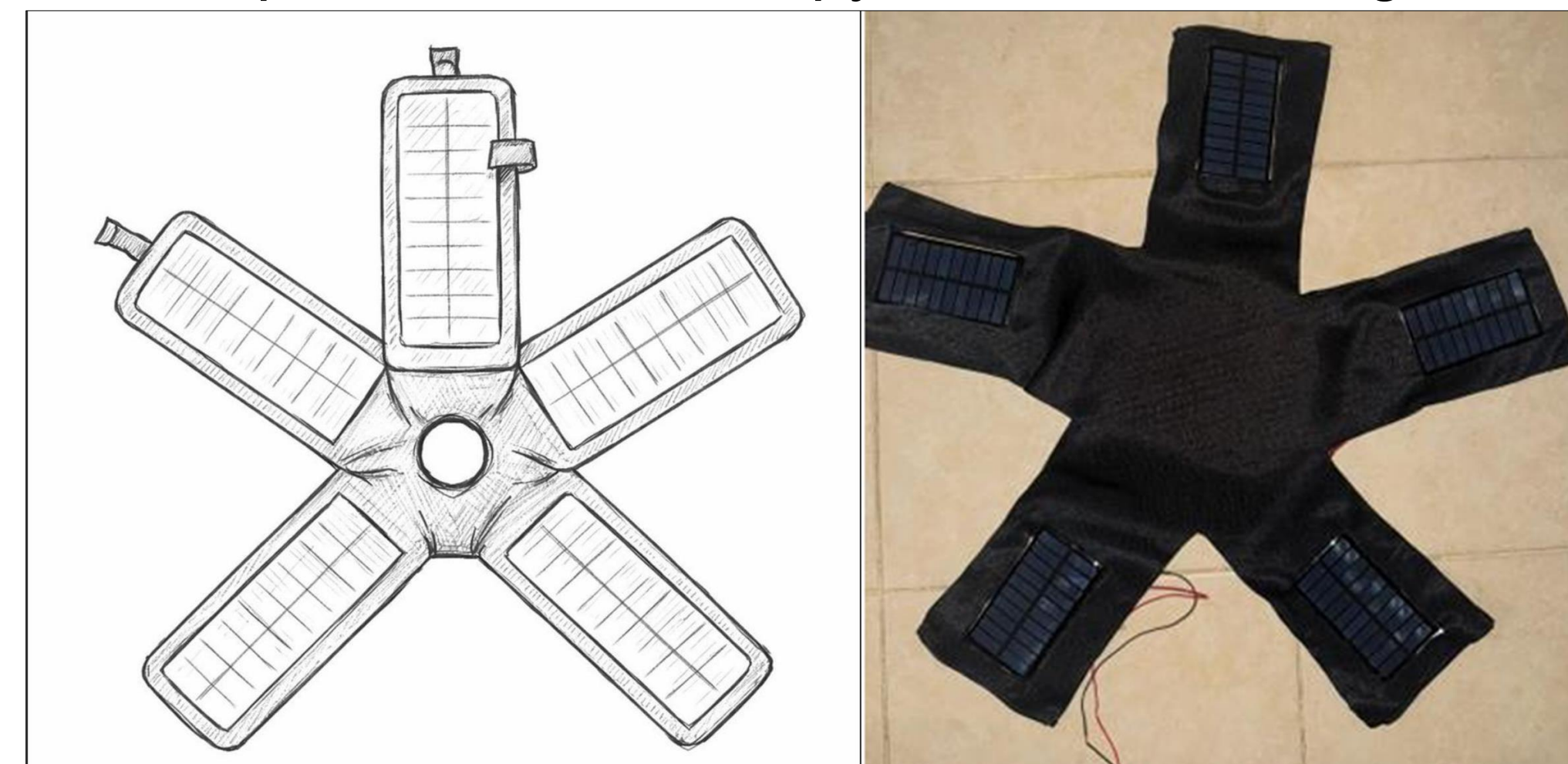
5. Reliability & Materials: Auto-reconnect system, non-toxic & UV-resistant

System Design

The Smart Hajj Umbrella combines multiple subsystems into one integrated design:

Solar Power Subsystem

5 solar panels on the canopy in a textile casing.



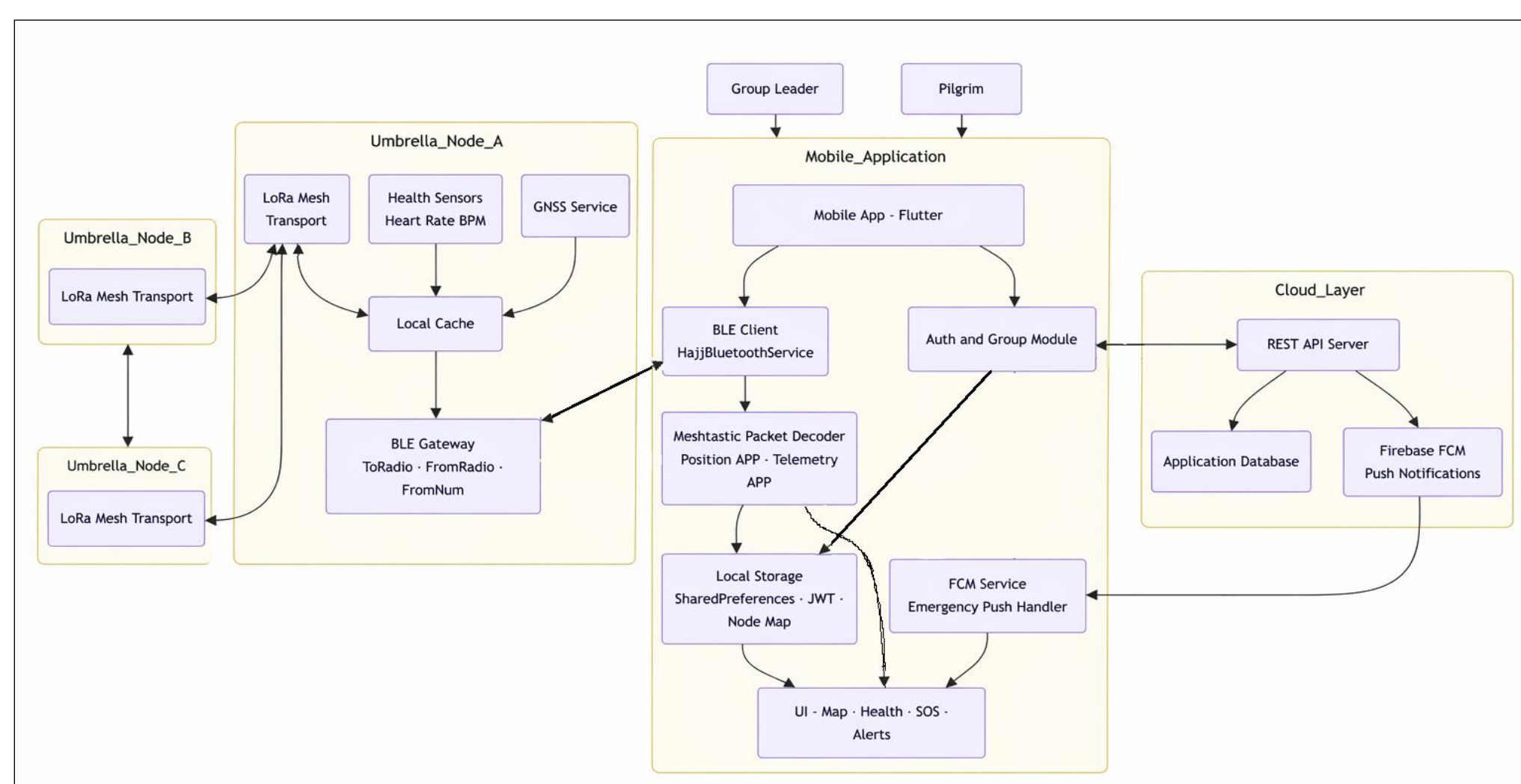
Cooling Subsystem

Compact axial fan generating airflow of 2 m/s.



Tracking & Sensors Subsystem

Location and health tracking via LoRa.

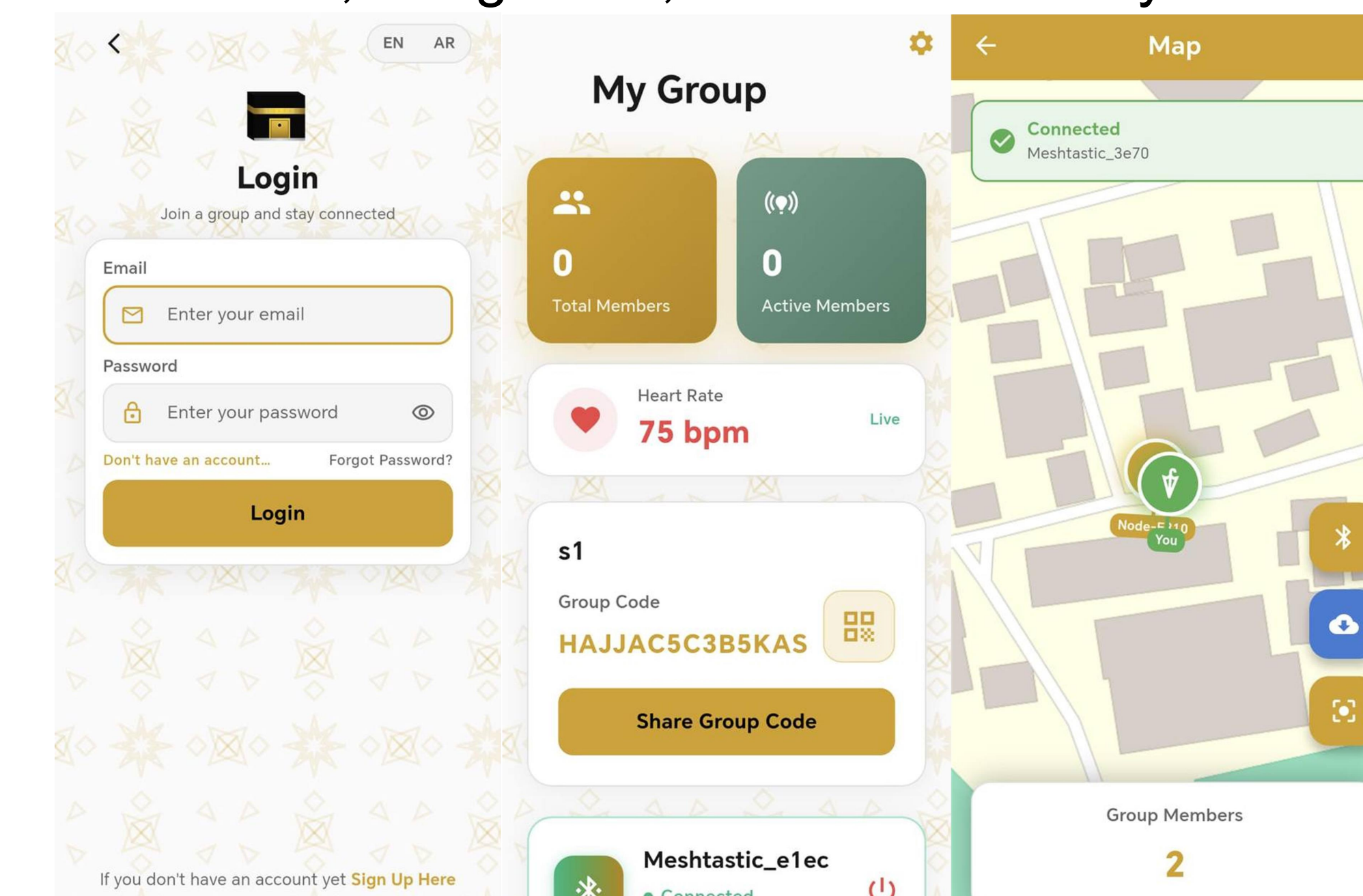


Prototype

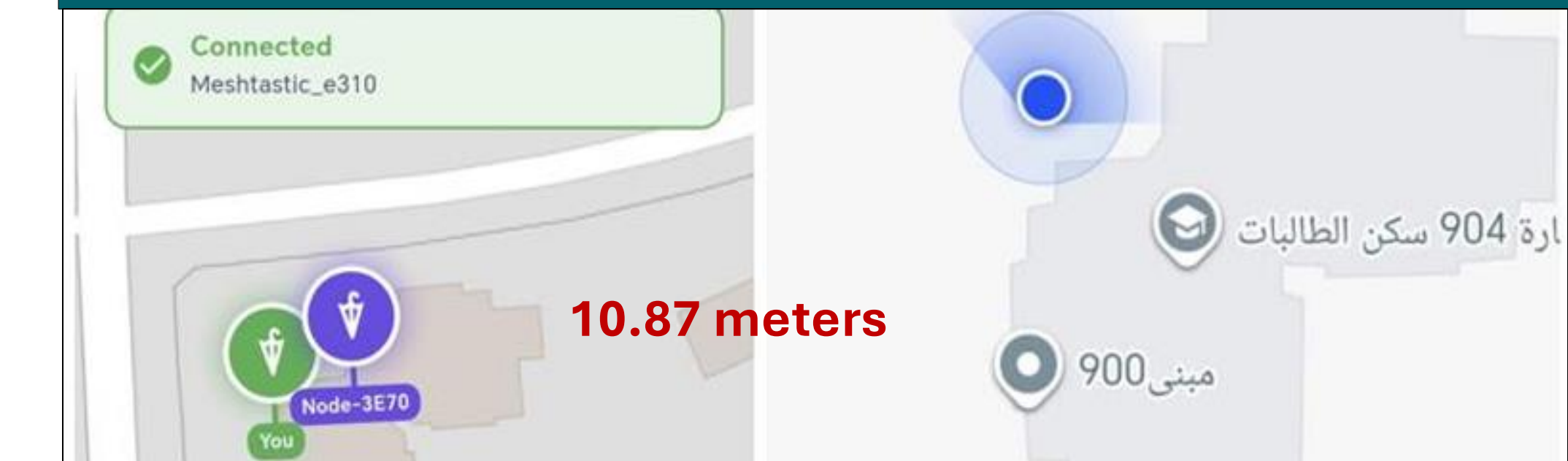
Foldable umbrella with internal wiring, fan, solar panels, and a 3D-printed handle encloses electronics, sensors, battery, and communication modules.



Mobile app with real-time health, location tracking, SOS alerts, bilingual UI, and offline auto-sync.



Testing & Results



1. Tracking: Accurate GPS tracking with LoRa (20-30m accuracy)



2. Power: 6-9 hours of operation, solar-assisted charging.



3. Reliability: Accurate sensing (± 3 bpm)



4. Portability: Lightweight (< 2 kg), foldable, and easy to use.

5. Thermal Performance: Fan capable of 2 m/s airflow.