Atmospheric Energy Harvester for Mobile Devices

The present invention discloses a compact, mobile-integrated atmospheric energy harvesting system that captures ambient electromagnetic, thermal, and kinetic energy for supplemental charging of portable electronics.

The harvester incorporates a hybrid nano-material mesh consisting of triboelectric nanogenerators (TENGs), thermoelectric converters, and RF energy scavengers. These layers are embedded within the rear casing of the device or as part of a wearable module.

The RF harvesting array uses a tunable metamaterial to adapt to local frequency bands, maximizing energy intake from Wi-Fi, cellular, and broadcast signals. The thermoelectric grid captures gradient differences between the device's surface and ambient air, while TENG layers harvest energy from motion, touch, and vibration.

An intelligent energy management IC coordinates harvesting operations, prioritizing sources based on efficiency curves and user power needs. Collected energy is either stored in dedicated micro-supercapacitors or redirected to support system operations like location tracking, low-power sensors, or emergency SOS signaling.

To complement traditional charging methods, the system features a dynamic charging policy that can alert users to nearby ambient energy fields and optimize placement for maximal harvesting. The casing material doubles as a heat spreader and protective insulation, maintaining optimal operation temperature.

This invention greatly enhances the autonomy and sustainability of mobile devices, particularly in

off-grid, emergency, or low-accessibility environments, reducing dependency on centralized power infrastructures.