

HLPP: Hardware-Level Persistence Protocol

A Framework for Silicon-Level Resilience and E-Waste Mitigation

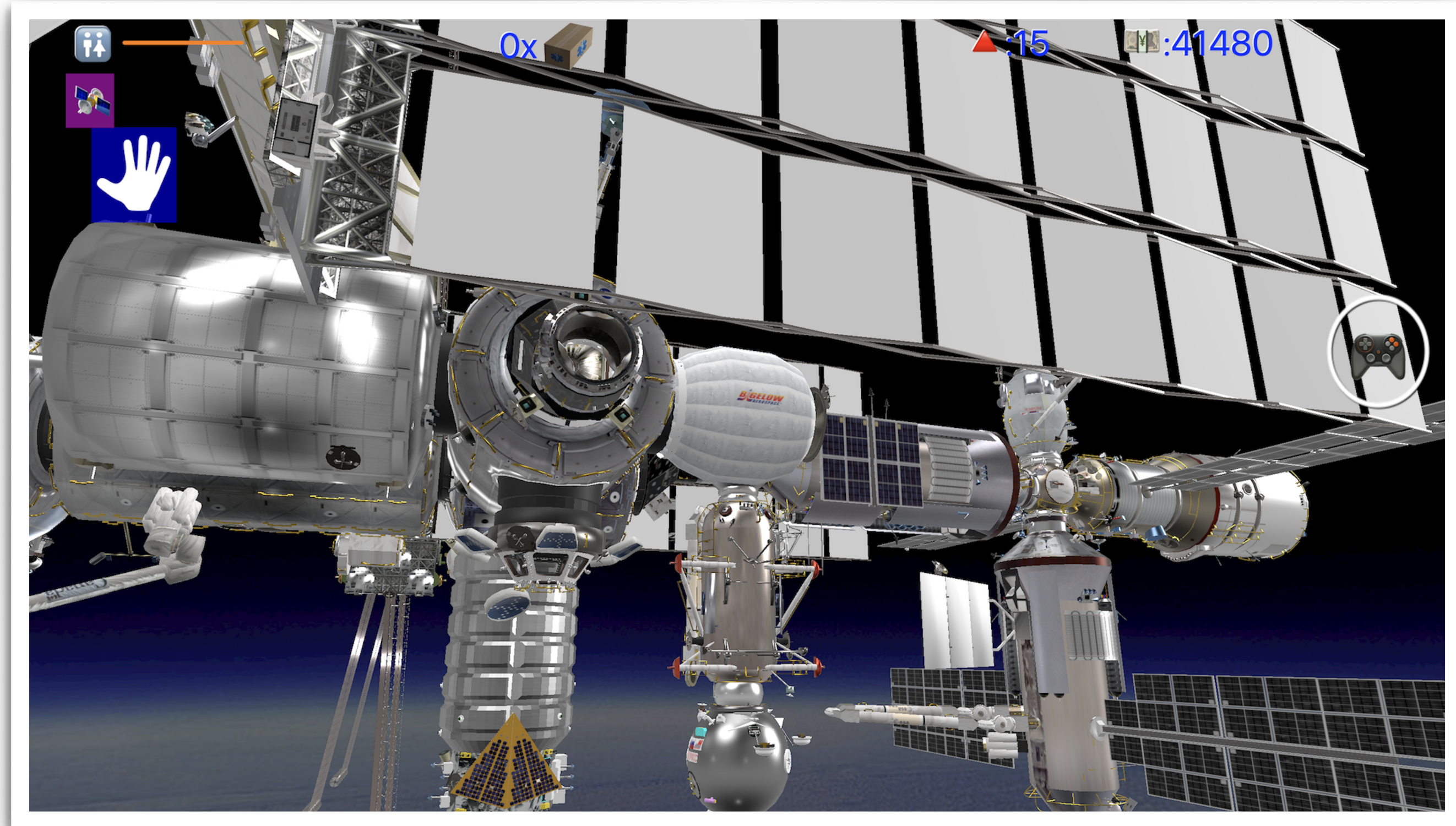
Affiliation: OSTOURA Research Initiative (Egypt / Philippines)

Mission: Extending the functional lifecycle of ARM and RISC-V architectures through "Persistence-by-Design."

Technical Background & Systems Expertise

- **System Architecture:** Over 10 years of experience in low-level ARM/RISC-V assembly and embedded control logic.

- **Mission-Critical Simulation:** Lead developer for Space Survivor VR/AR, a high-fidelity simulator for the International Space Station (ISS) systems.



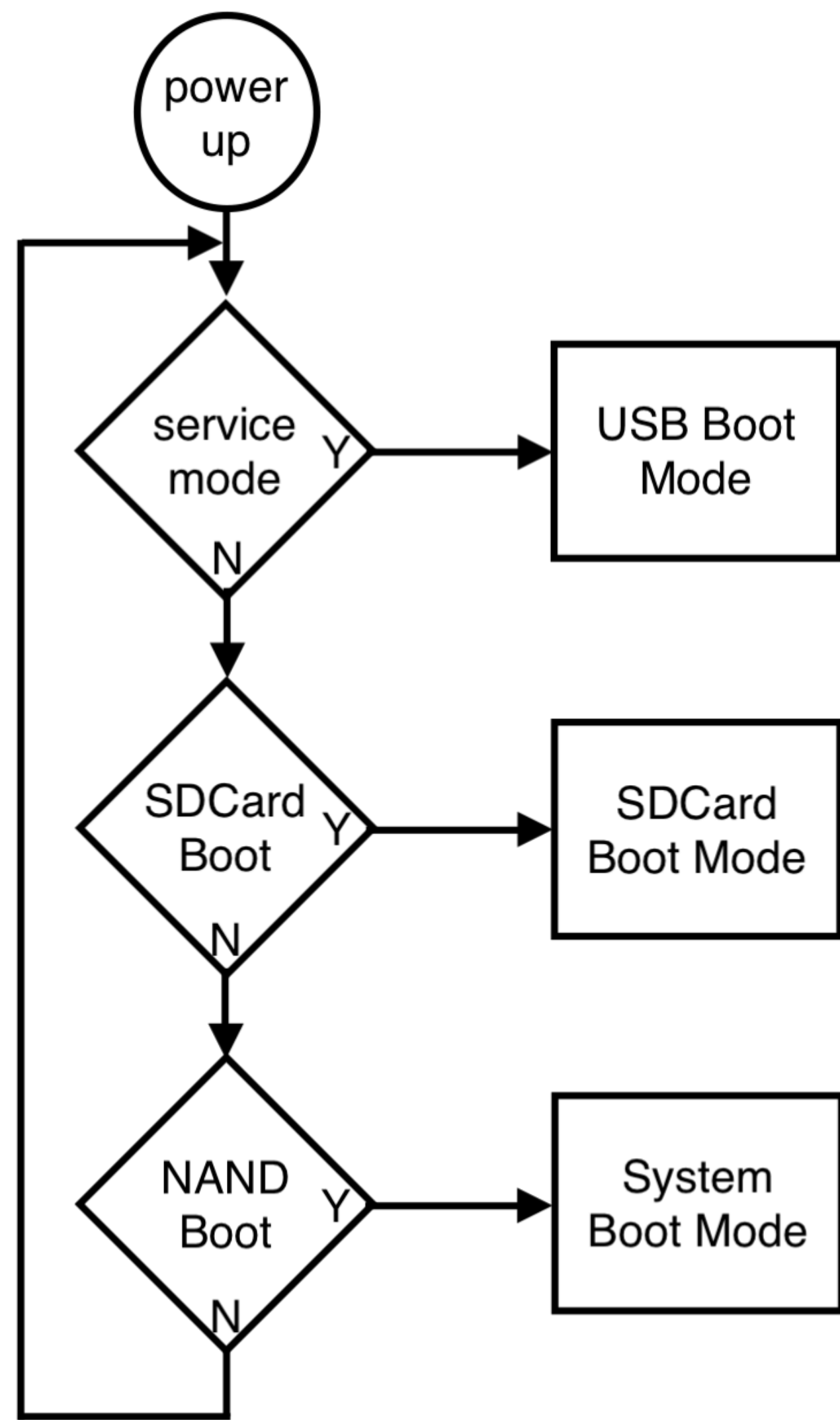
- **Sustainability Research:** Founder of the OSTOURA Research Initiative, focusing on silicon-level functional resilience (HLPP).

"If we can simulate mission-critical life support in space, we can engineer functional resilience for discarded silicon on Earth."

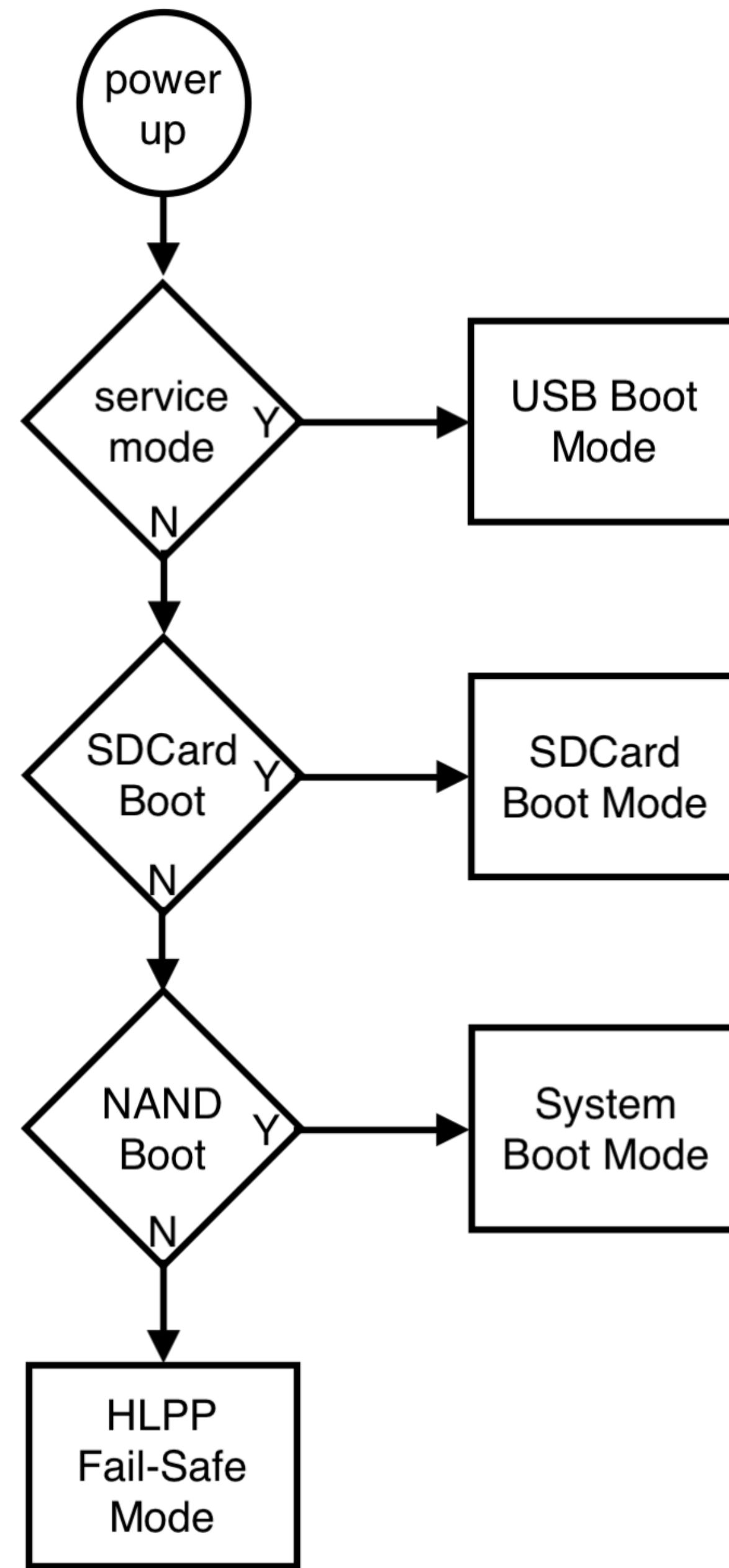
The "End-of-Utility" Crisis

Why functional silicon is discarded prematurely.

- **Multifaceted Failure Points:** It is not only due to total damage. Devices are discarded due to:
 - **NAND Failure:** Almost 80% of the cases the Internal Storage (NAND) fail, preventing startup, factory reset or install firmware, In many cases the screen does not even turn on.
 - **Software Abandonment:** Apps no longer support the OS version (Outdated).
 - **Peripheral Damage:** Broken touchscreens or buttons making standard UI unusable.
- **The "E-Waste Impulse":** The moment a user perceives a device as "non-functional," it is headed for a landfill.
- **The Invisible Resource:** In 90% of these cases, the **CPU, RAM, and Power Management** are still in perfect health.
- **The Problem with Recycling:** Shredding a device to recover 2 grams of copper is inefficient compared to keeping the **entire silicon system** running for a new purpose.



- Standard Boot trap Loop



- HLPP Fail-Safe Solution

The HLPP Implementation Strategy

Rescuing legacy hardware while engineering the future.

- **Proof of Concept:** Utilizing low-level assembly injection to restore utility to millions of currently "bricked" or outdated legacy devices.
- **The "Fail-Safe" Standard:** Proposing that future SoC architectures include a built-in, lightweight HLPP layer to ensure functional resilience regardless of storage or peripheral failure.
- **Manufacturer Contributions:** Inviting SoC vendors to join the "Elite Sustainability Club" by contributing register-level specifications for their legacy chips to the open-source HLPP protocol.

HLPP Rescued Devices



- Allwinner (A13)
- iTechie iT708

- RockChip (RK2926/RK2928)
- TouchMate TM-MD710

- Actions Semiconductor (ATM7021) - Zentality C701

Case Studies & Verification

Proven success on high-waste legacy architectures.

- **Allwinner (A13) - iTechie iT708** : Verified recovery using SD Card or FEL-mode injection for circular economy use.
- **RockChip (RK2926/RK2928) - TouchMate TM-MD710** : Implementation of functional recovery paths for secondary life cycles.
- **Actions Semiconductor (ATM7021) - Zentality C701** : Successful NAND-independent boot and functional persistence.
- **RISC-V (ESP32-C3) - 5.5" B/W TV A/V**: development of 160MHz bare-metal drivers to demonstrate scalability on modern open-source silicon to rescue legacy devices like 5.5" CRT B/W TV.

The "Silicon Immortality" Ecosystem

A Win-Win Framework for Industry and Environment.

- **The "Immortal Device" Certificate:** Adoption of the HLPP protocol grants manufacturers a formal ISO/ITU Sustainability Certification. This "Seal of Immortality" allows brands to capture a larger market share by guaranteeing a perpetual hardware life.
- **The Elite Club (New/Current Products):** Manufacturers commit to integrating a built-in "Functional Fail-Safe" in all current and future silicon designs, ensuring the device remains a functional asset beyond its primary OS life.
- **The "Extra Star" Recognition (Legacy Support):** Existing members receive "Extra Star" status by contributing register-level code to the HLPP project, enabling the rescue of millions of their already-produced legacy SoCs.
- **Market-Share Philosophy:** High-resilience products justify premium positioning and build long-term brand loyalty. Sustainability is no longer a cost—it is a Profit Driver.

Building the Future of Silicon Resilience

Join the HLPP Initiative.



- **HLPP Github:** Scan to connect for technical discussion and collaborative inquiries.
- **LinkedIn:** www.linkedin.com/in/ahmed-e-4a5937162
- **Email:** ostoura@yahoo.com
- **Location:** Giza, Egypt / CDO, Philippines

"Let's ensure that silicon immortality becomes a global reality."