Building in Public: Hardware V1.0

The Open-Source Second Brain.

A hybrid-architecture wearable designed for low-power autonomy and high-performance edge AI. Join us as we build the skeleton of the ultimate screenless interface.

Explore the Docs

Join the Discussion

The Hybrid Engine: Brain vs. Muscle

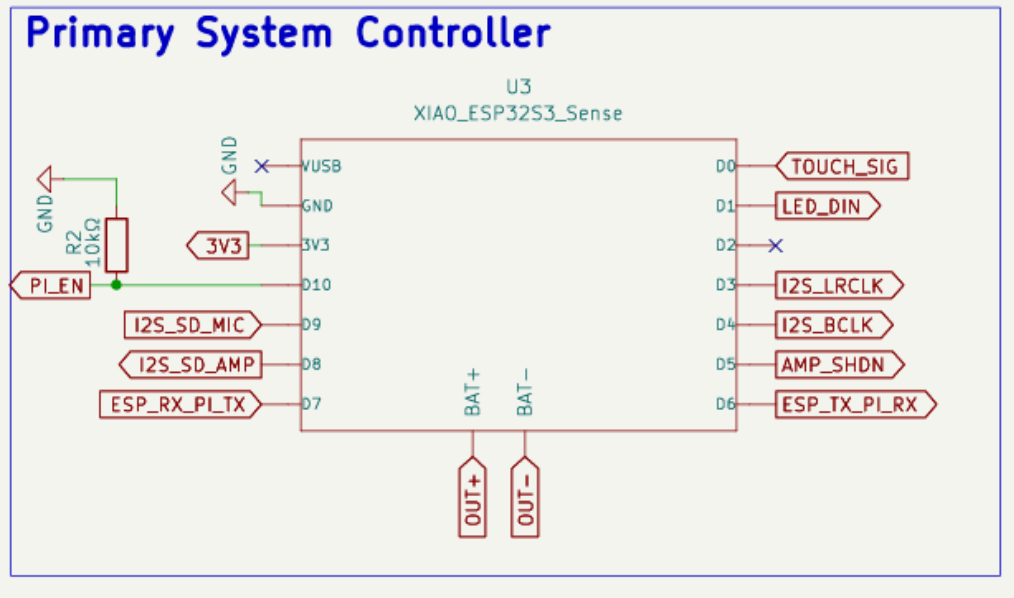
Consumer wearables die in hours because they rely on a single, power-hungry processor to do everything. CAIPO Dev Kit V1.0 splits the workload using a “Primary/Secondary" architecture.

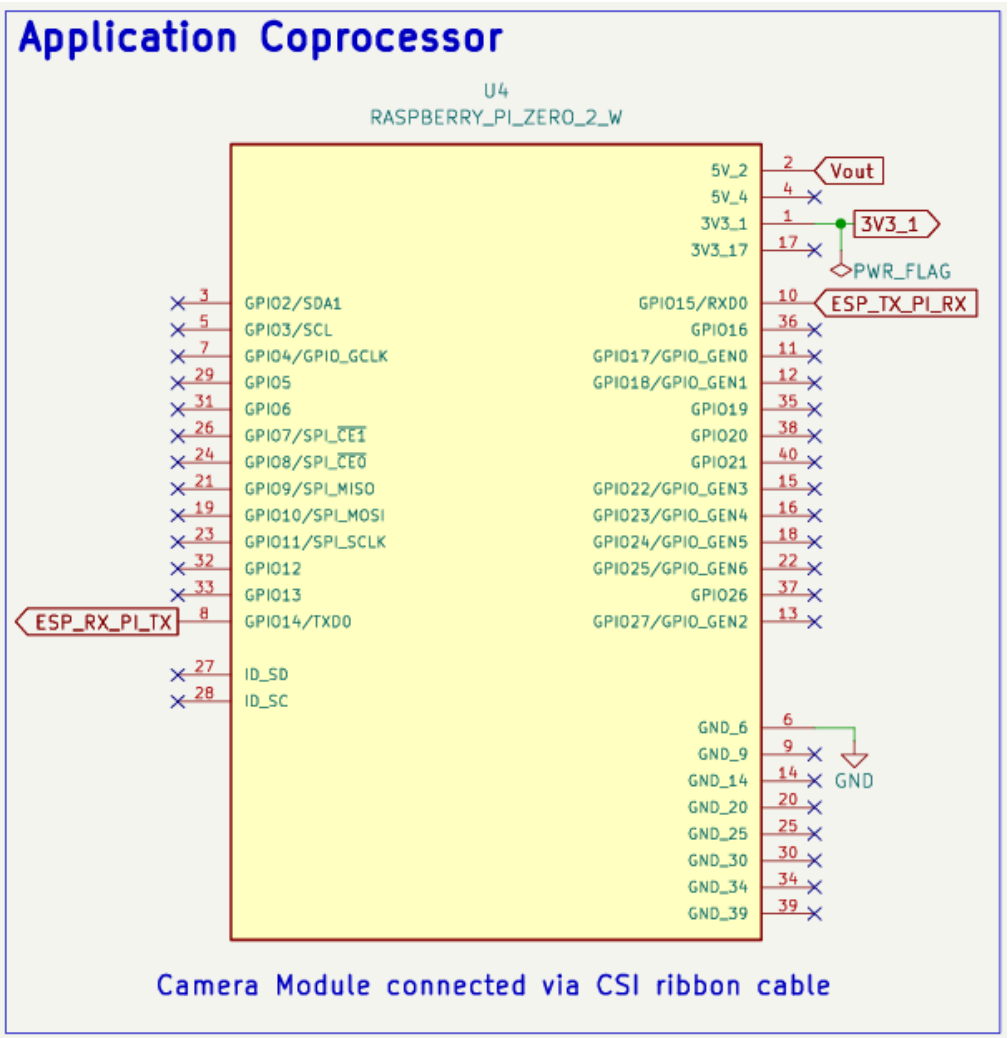
- **The Sentry (ESP32-S3)**

The "Brain" runs on bare-metal C++. It is always awake, managing the touch sensor and buffering microphone audio while drawing mere micro-amps of power.

- **The Heavy Lifter (Pi Zero 2 W)**

The "Muscle" runs a full Linux OS for LLM routing and NLP. It remains completely dead (0mA) until the Sentry wakes it up via a UART interrupt.


Primary System Controller
U3
XIAO_ESP32S3_Sense
GND
R2
10kΩ
3V3
PI_EN
I2S_SD_MIC
I2S_SD_AMP
ESP_RX_PI_TX
VUSB
GND
3V3
D10
D9
D8
D7
BAT+
BAT−
OUT+
OUT−
D0
D1
D2
D3
D4
D5
D6
TOUCH_SIG
LED_DIN
I2S_LRCLK
I2S_BCLK
AMP_SHDN
ESP_TX_PI_RX


Application Coprocessor
U4
RASPBERRY_PI_ZERO_2_W
5V_2
5V_4
3V3_1
3V3_17
Vout
3V3_1
PWR_FLAG
GPIO2/SDA1
GPIO3/SCL
GPIO4/GPIO_GCLK
GPIO5
GPIO6
GPIO7/SPI_CE1
GPIO8/SPI_CE0
GPIO9/SPI_MISO
GPIO10/SPI_MOSI
GPIO11/SPI_SCLK
GPIO12
GPIO13
GPIO14/TXD0
ESP_RX_PI_TX
ID_SD
ID_SC
GPIO15/RXD0
GPIO16
GPIO17/GPIO_GEN0
GPIO18/GPIO_GEN1
GPIO19
GPIO20
GPIO21
GPIO22/GPIO_GEN3
GPIO23/GPIO_GEN4
GPIO24/GPIO_GEN5
GPIO25/GPIO_GEN6
GPIO26
GPIO27/GPIO_GEN2
ESP_TX_PI_RX
GND_6
GND_9
GND_14
GND_20
GND_25
GND_30
GND_34
GND_39
GND
Camera Module connected via CSI ribbon cable

"Sip vs. Gulp" Power Philosophy

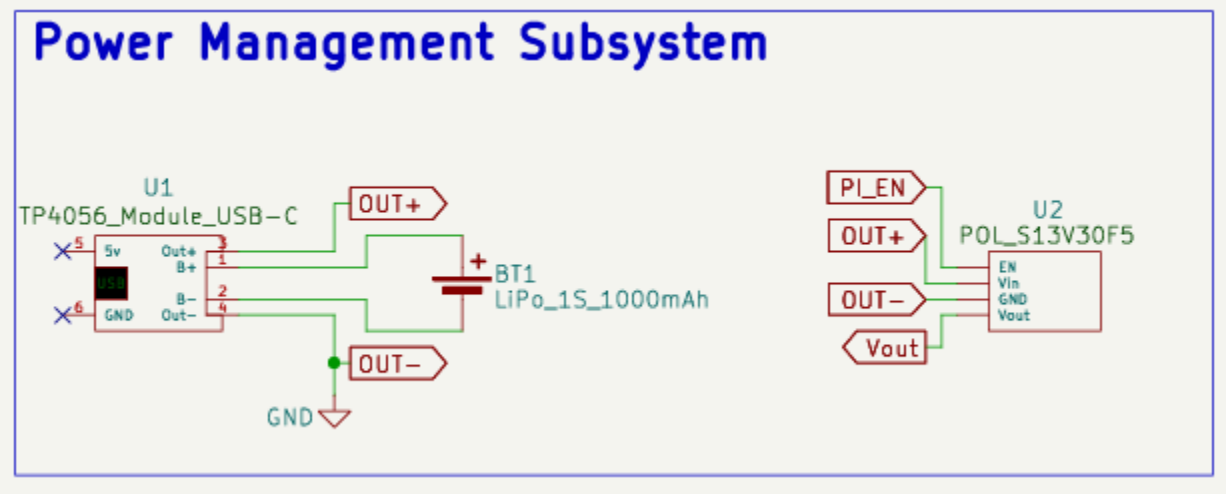
The biggest mistake in wearable DIY projects is powering audio amplifiers directly from the microcontroller. The ESP32 *sips* power. The MAX98357A Amplifier and Raspberry Pi *gulp* power. If they share a direct line, the system crashes.

The Safety Architecture

We completely isolated the power rails. The battery feeds the TP4056, which provides a 3.7V rail for the ESP32. The Pi is hidden behind a dedicated Pololu S13V30F5 5V Step-Up Regulator.

The PI_EN Trick

How does the ESP32 wake a dead Pi? We connected ESP32 Pin D10 to the regulator's Enable (EN) pin. The ESP32 acts as a physical light switch, completely severing power to the Pi to achieve true zero-drain standby.



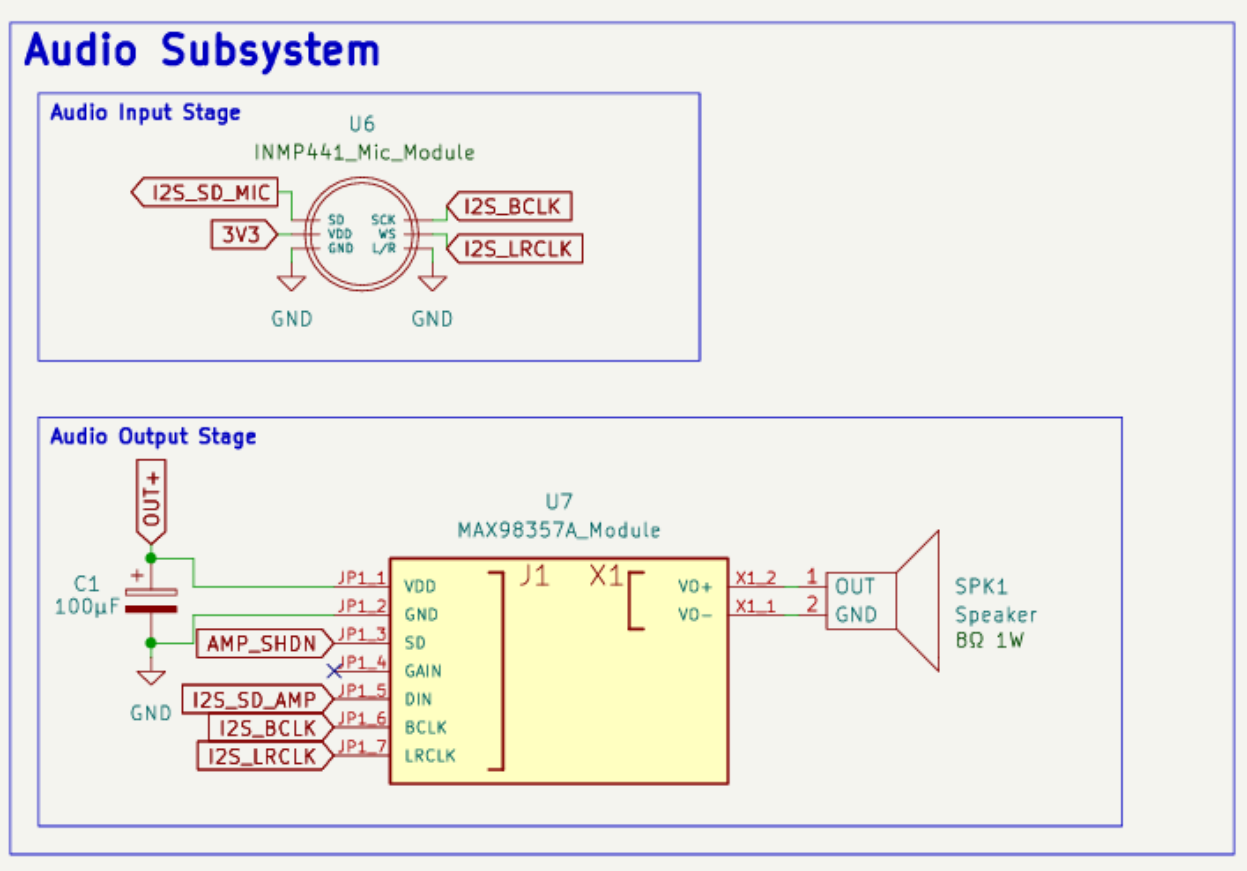
Pure Digital Audio & Hardware Agnosticism

Analog microphones pick up massive electromagnetic interference (EMI) when placed next to Wi-Fi antennas. To guarantee crystal-clear voice data for our AI models, CAIPO relies exclusively on the I2S (Inter-IC Sound) digital protocol.

We use the **INMP441** mic and **MAX98357A** amp for our V1.0 baseline because they hit the perfect sweet spot between audio clarity and Bill of Materials (BoM) cost optimization.

Bring Your Own Sensors

We know supply chains vary globally. Can't source an INMP441 in your region? No problem. **CAIPO is hardware agnostic by design.** As long as your sensor speaks I2S or I2C, our open-source codebase can be adapted. We encourage the community to test alternative sensors and push the drivers back to our repo.



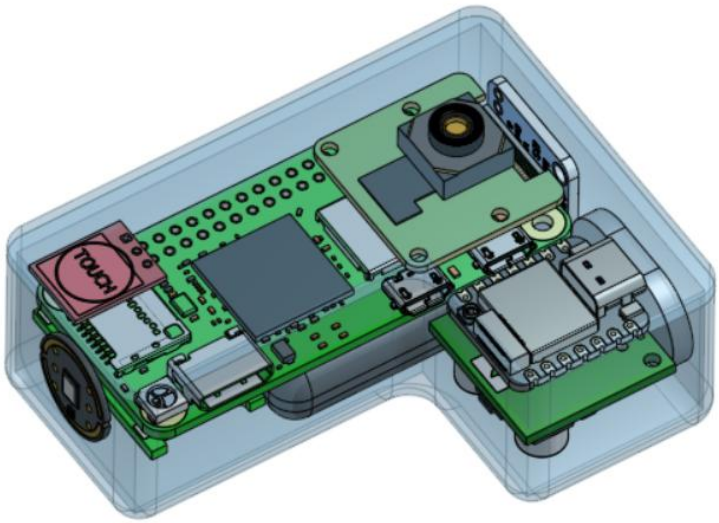
Designed for Desk-Assembly

We aren't assuming everyone has a pick-and-place factory. The upcoming CAIPO V1.0 case is being designed specifically for standard FDM 3D Printers (PLA/PETG).

- **Thermal Management:** The case will have vents for passive cooling positioned directly adjacent to the Pi's CPU and the voltage regulator.
- **Snap-Fit Component Cradles:** No messy glue required. Internal printed ribs will allow the PCB boards to friction-fit securely into place.
- **Invisible UI:** The TTP223 touch sensor operates perfectly through 2mm of printed plastic, keeping the exterior sleek and water-resistant.

CAD Models Dropping Soon

We are finalizing the 3D printable files. Stay in touch with us! Once released, you will be able to download and adapt the first case design—perfect for adding your own initials or embossing your school/university logo right onto the device.



Bill of Materials (V1.0 Dev Kit)

Ready to build? Here are the core components you need to source.

Ref	Component / Function	Specific Part	Connection
U3	**Primary System Controller** (The Brain)	Seeed Studio XIAO ESP32-S3	Main 3.7V Rail
U4	**Application Coprocessor** (The Muscle)	Raspberry Pi Zero 2 W	5V Regulator Out
U1	**Power Management** (Charging)	TP4056 USB-C Module	Battery / System Rail
U2	**Voltage Step-Up** (Pi Power)	Pololu 5V (S13V30F5)	Controlled via PI_EN
U5	**User Interface** (Wake)	TTP223 Touch Sensor	ESP32 Pin D0
U6	**Digital Audio Input** (Mic)	INMP441 MEMS Mic	ESP32 (I2S Bus)
U7	**Digital Audio Output** (Amp)	MAX98357A Class-D	ESP32 (I2S Bus)
SPK1	**Audio Output** (Speaker)	WS2812B	Amp output pins
D1	**Status Indicator** (LED)	uxcell 1W 8 Ohm	ESP32 Pin D1

Help Us Build the Muscle

The hardware skeleton is ready. Now our Multimodal Perception, Neuroscience, and Space teams are building the AI software layer. We want you involved.

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