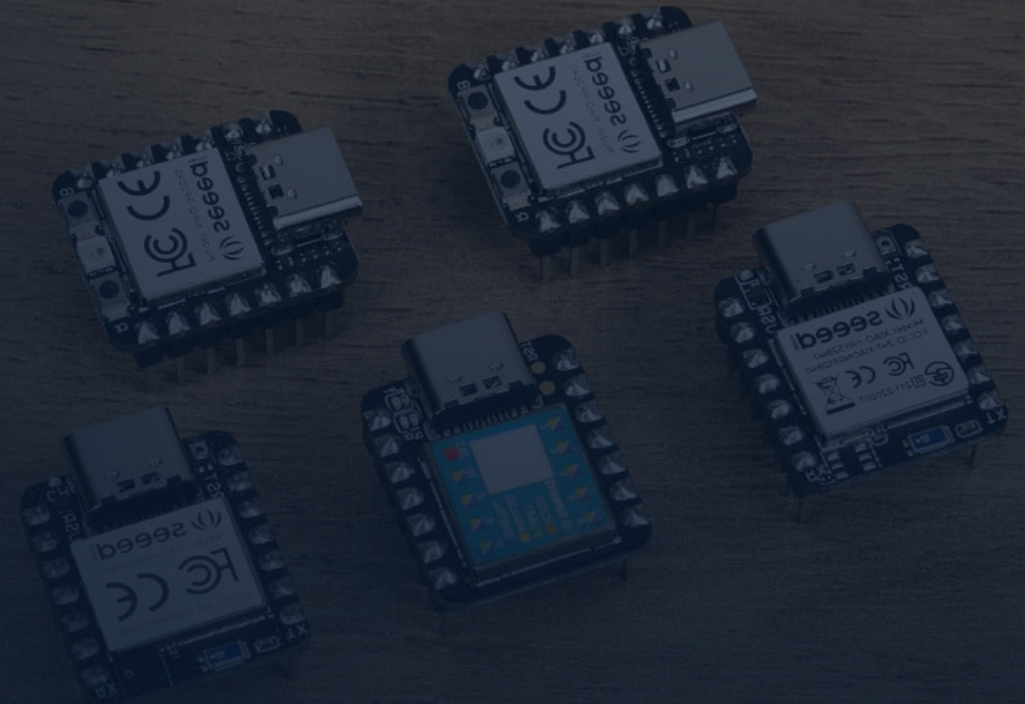seeed studio

Seeed Studio XIAO Reference Design

Seeed Studio XIAO Series: Small in Size, Big on Features

Seeed Studio XIAO Series

Extremely Compact Development Boards That Can Act as Functional Modules in Your Designs

XIAO is a series of ready-for-production developmemt boards with compact design, thumb-sized form factor, powerful processors, and rich peripherals. As a complete microcontroller with all SMD components placed on the same side of the board, it is also a functional module that can act as a building block for larger compute systems so as to simplify the process of designing and building complex electronic systems by providing a pre-integrated and tested platform. By adopting XIAO, you can focus on creating the unique features and functions of your system, without having to worry about the time and effort involved in integrating and testing the individual components.

Seeed Studio XIAO Comparision Table

	Seeed Studio XIAO SAMD21	Seeed Studio XIAO RP2040	Seeed Studio XIAO nRF52840	Seeed Studio XIAO nRF52840 Sense	Seeed Studio XIAO ESP32C3	Seeed Studio XIAO ESP32S3	Seeed Studio XIAO ESP32S3 Sense
Short Description	Universal With Strong Stability and Compatibility	Compatible with the Raspberry Pi RP2040 ecosystem	Ultra-low power consumption Bluetooth 5.0 Suitable for consumer-grade product applications	Advanced Version of XIAO nRF52840 With Onboard Microphone And 3-Axis IMU	With WiFi and BLE, Budget-Friendly Risc-V	With WiFi and BLE, High Performance	Advanced Version of XIAO ESP32S3 with OV2640 Camera and Microphone
Recommend-ed Application	Oceanic Observation; Healthcare Device; MIDI / Audiovisual Control; UAVs; Light Controller; Digital Sinage; Digital Relay Timer; Scooter; Tracker	Mechanical Keyboards; HDMI; Geotechnical Sampling Tools; Environmental Detection Tools	Smart Home Device; Elderly Care Device	AR / Virtual Reality; Creative Therapy Devices; Biomechanics Body Movement Sensor; Sports Data Collection	Smart Agriculture; Smart Home Solution	Robotics; Low-Power Networking; Smart Watch; Smart Thermostat	Image Recognition; Speech Recognition; TinyML
Chip	Microchip SAMD21	Raspberry Pi RP2040	Nordic nRF52840	Nordic nRF52840	Expressif ESP32C3	Expressif ESP32S3	Expressif ESP32S3
Architecture	Cortex-M0+ running up to 48MHz	Dual-core Cortex-M0+ running up to 133 MHz	Cortex-M4 running up to 64 MHz	Cortex-M4 running up to 64 MHz	RISC-V running up to 160 MHz	Dual-core Xtensa LX7 running up to 240 MHz	Dual-core Xtensa LX7 running up to 240 MHz
RAM	32 KB SRAM	264 KB SRAM	256 KB RAM	256 KB RAM	400 KB SRAM	512 KB SRAM + 8MB PSRAM	512 KB SRAM + 8MB PSRAM
Flash&ROM (chip)	256KB	x	1MB	1MB	4MB	384KB	384KB
Flash (onboard)	x	2MB	2MB	2MB	x	8MB	8MB
Built-in Sensors	x	x	x	IMU, Microphone	x	x	OV2640 camera, Microphone
PWM/Analog Pins	11/11	11/4	11/6	11/6	11/4	11/9	13/11
I2C/UART/SPI	√	√	√	√	√	√	√
Buletooth	x	x	√	√	√	√	√
WiFi	x	x	x	x	√	√	√
Reset Button	x	√	√	√	√	√	√
Boot Button	x	√	x	x	√	√	√
User LED	√	√	√	√	x	√	√
Baterry Charge LED and chip	x	x	√	√	√	√	√
Low power mode	x	x	5μA	5μA	44μA	14 μA	26.5 mA

	Seeed Studio XIAO SAMD21	Seeed Studio XIAO RP2040	Seeed Studio XIAO nRF52840	Seeed Studio XIAO nRF52840 Sense	Seeed Studio XIAO ESP32C3	Seeed Studio XIAO ESP32S3	Seeed Studio XIAO ESP32S3 Sense
Programming Languages							
Arduino	√	√	√	√	√	√	√
CircuitPython	√	√	√	√	√	x	x
MicroPython	√	√	√	√	√	√	√
SKU	102010328	102010428	102010448	102010469	113991054	113991114	113991115

Seeed Fusion One-Stop Shop Agile Manufaturing and Hardware Customization, Has You Covered All From Ideas Prototypes to Large Scale Production

What can Seeed Fusion do for you?

● Provide complete Original Equipment Manufacturing services for a wide variety of electronic hardware, lifting your design from idea to reality

● Bring your product concept to the market with Seeed Studio's industrial capabilities from design, manufacturing,testing, certification, global distribution, and Seeed co-create lisencing program

● Offer the entire package from PCB manufacture, parts procurement, turn-key assembly, mechanical parts manufacture, packaging services, quality inspections down to shipping provisions, structural and certification such as FCC, CE, Telec, andmanufacturing for enclosures and hardware, etc. complete with dedicated account managers and expert engineers, Seeed can help you realize your ideas economically and efficiently

In a nutshell, whether you are prototyping or looking for a mass production partner or based on open source product customization requirements and other design manufacturing services, Seeed Studio Fusion service is catered to your needs starting with a simple online platform.

As a series of highly versatile functional modules that has been widely adopted by product designers, XIAO Series shows its limitless possibilities in a range of amazing designs. Here are some reference designs powered by XIAO and Seeed Fusion's agile manufacturing service. Check them out below for inspiration!

Tools & Accessories

SenseCAP Sensor Builder, an Open-Source Tool to Build RS485 Sensors With Grove

Powered by Seeed Studio XIAO RP2040 dual-core ARM M0+ processor, with a USB-C port for easy code uploading, this design can convert 500+ existing Grove sensors to MODBUS RS485 industrial-grade sensors. You can easily finish the upgrade from maker/Arduino products to industrial-level products. Six popular environmental Grove sensors are already fully compatible with native firmware. It is compatible with your data logger and IoT platform. An IP66 waterproof rate outdoor enclosure with a customized mounting panel is included, suitable for pole and wall installation.

Keywords:

Industrial Sensor Converter
Environmental Sensing Tool

SenseCAP S2110 Sensor Builder
An open-source tool to build RS485 sensors with Grove

>> Read More Details

Tools & Accessories

PCB Hotplate Powered by XIAO SAMD21

The temperature of the heating coil is displayed on an OLED screen. The XIAO SAMD21 board, which measures only 20.3mm x 17.8mm, is used to power the system. PCBs are used for the creation of coils directly on the board layer, which can then be used as heating elements. This is because when electricity is passed through a material with some resistance, heat is generated. By designing coils on the PCB, each 1mm wide with a resistance of 2.2 ohms, electricity can be passed through them, and they heat up to create a small heating element. PCB design and fabrication are easy and hassle-free, allowing for quick and efficient production.

Keywords:

Laboratory Device
Melting&Heating Device

Tools & Accessories

Current Measuring Tool Using XIAO ESP32C3 & ACS758 Sensor

This design demonstrates how to accurately measure current using the XIAO ESP32C3 and ACS758 sensor, which is essential for electronic projects and power measurement and control applications. The XIAO ESP32C3 board can read current data through code, providing accurate measurements. The designer also covers practical tips for calibrating the sensor and optimizing its performance, making this design useful for hobbyists, students, and professional engineers alike.

Keywords:

Electrical Maintenance & Troubleshooting
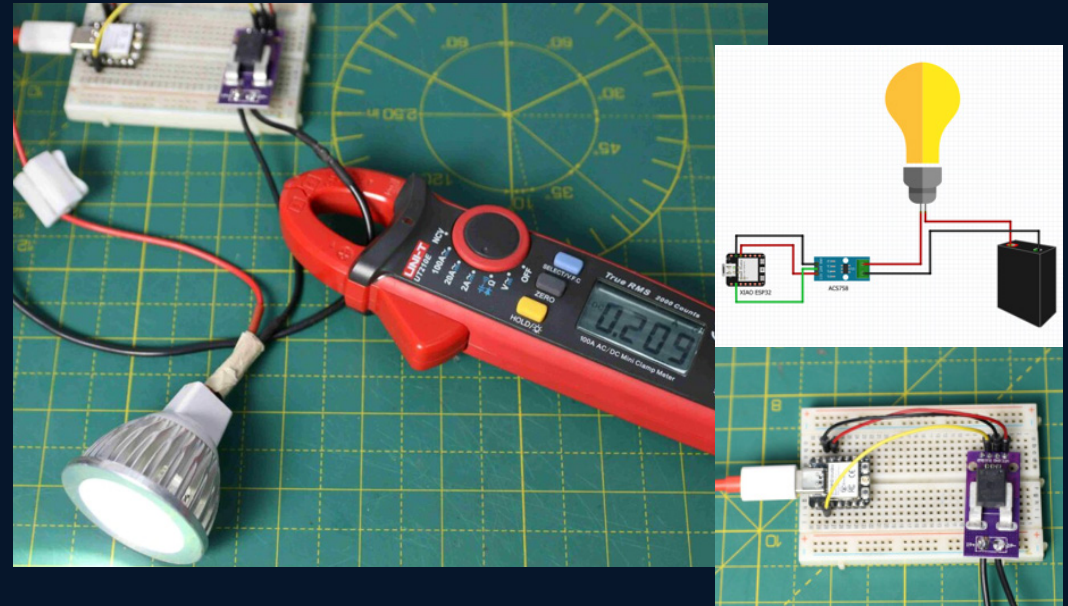
Solar Power Monitoring

Solar PV Monitoring System Powered by Seeed Wio-E5 Module, XIAO RP2040 & Fusion PCBA Service

This design demonstrates how to build a LoRa®-enabled solar power monitoring system. The system collects data from photovoltaic solar panels using XIAO RP2040 and transmits it wirelessly using Wio E5 modules. The data is then uploaded to a Qubitro cloud portal via Wireless Cellular IoT notecards in the base station. The system uses a Gravity I2C Wattmeter sensor to monitor the generated voltage and consumed power, a BH1750 Light Intensity sensor to monitor solar light intensity, and a Grove Temperature and Humidity sensor to monitor the temperature. Seeed Studio Fusion PCB Assembly service is used to design the system. The project aims to promote the use of solar energy by monitoring and conserving resources using LoRa®-enabled systems.

Keywords:

Solar PV (Photovoltaic) Monitoring;
Renewable Energy;
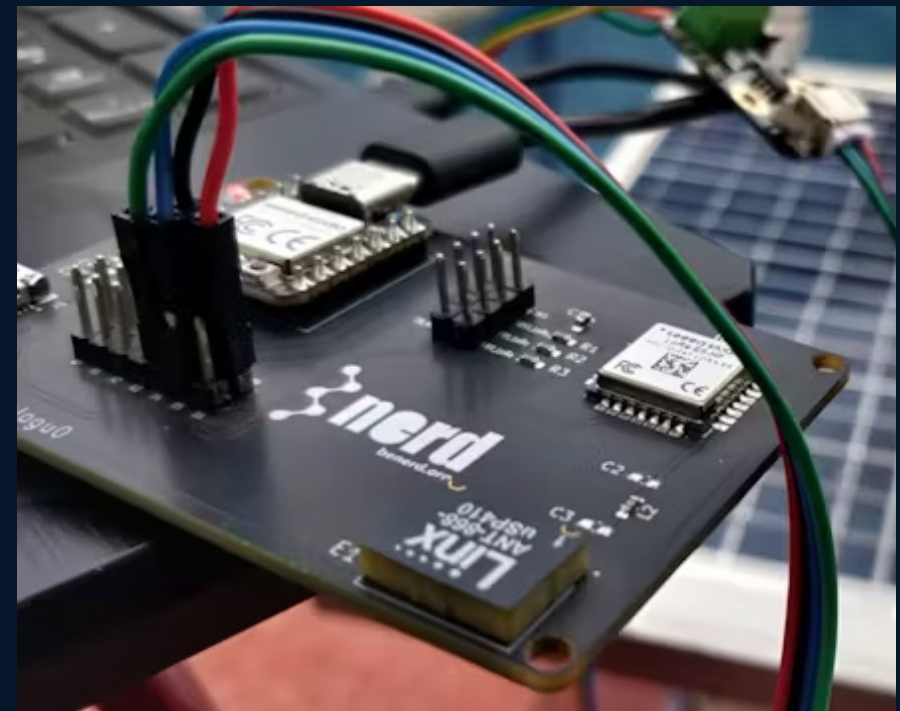
Solar Power Monitoring

Solar Charge Controller Powered by XIAO ESP32C3

This is an open-source solar charge controller that aims to replace PWM charge controllers. This design uses two channels of synchronous buck converters, allowing for an efficiency input and output. It can handle a high solar panel voltage of up to 90V, which also makes it budget-friendly. The design uses a Seeed XIAO ESP32-C3 module for sampling, calculating, and displaying the measurements on a 128x64 OLED display.

Keywords:

Solar Power Management
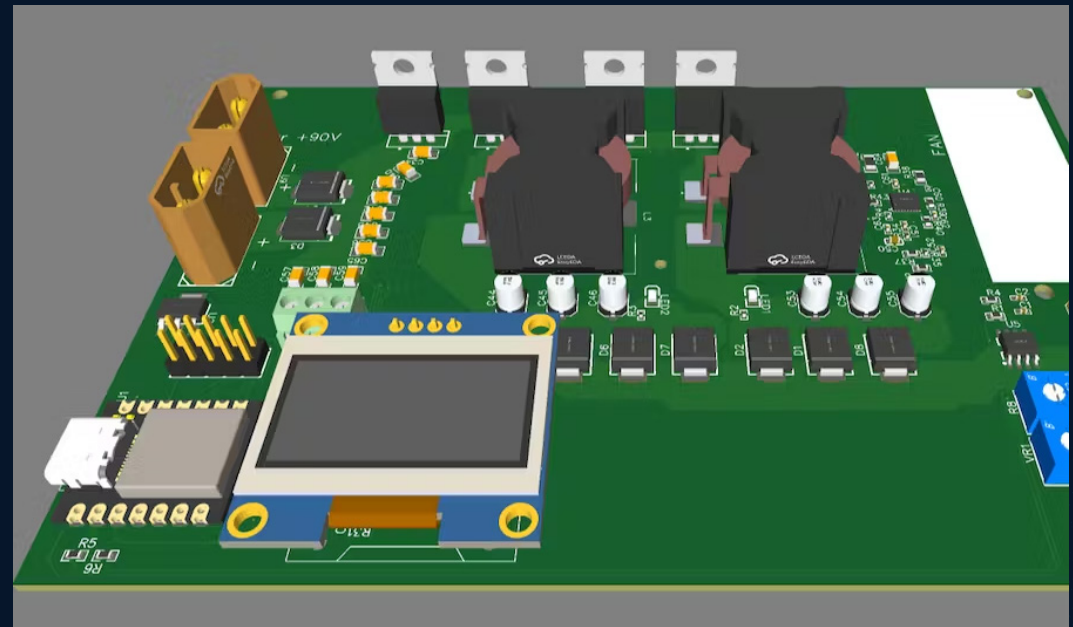
Wearables

Wearable Mouse Ring With Buttons & Wheel Based on XIAO nRF52840

This wearable mouse ring uses Seeed XIAO nRF52840, a custom 3D-printed ring and some very simple electronics. The designer created the ring to remove the mouse from the cockpit in his VR flight simulator sessions and create an immersive experience. The small size of the XIAO nRF52840 makes such a small wearable possible and allows enough room for a small Lithium-ion battery, on/off switch and four mouse buttons. The parts fit into the 3D-printed enclosure and the wires fit snugly into the built-in grooves. Finally, the designer uses a Leap Motion (a VR hand tracker) Controller with The Fingers software to register and simulate mouse movement and really make it feel like you are flying.

Keywords:

Virtual Reality

Musical

MIDI Device Based on XIAO SAMD21

Along with example code and diagrams, it is a reference design for those interested in creating their own MIDI controller using the XIAO SAMD21 board and Arduino programming. It includes detailed explanations of how to use the XIAO SAMD21 board to read MIDI signals from a device and transmit them to a computer or other MIDI device using Arduino. It also includes in-depth explanation of different MIDI messages and how to use them in programming.

**Keywords:**

Musical Instruments;
MIDI
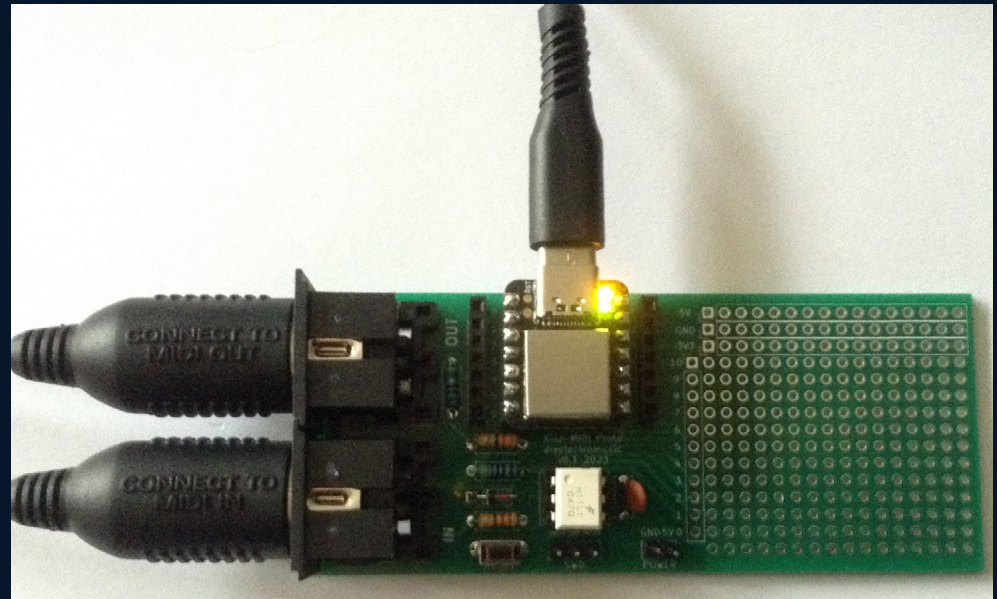
Robotics

A Mini Self-Balancing Robot Powered by XIAO ESP32C3

It is a self-balancing robot with three layers including a ground layer with an H-bridge motor driver, a second layer with a lithium cell and charging/boost IC, and a top layer with a Seeed XIAO ESP32C3 and an MPU6050 Module for gyro/accelerometer sensing. The robot uses a smaller 3V gear DC motor powered by a 3.7V 2200mAh lithium cell and an IP5306 Boost Module configuration. The project is still in its early stages, with code editing and motor driver tweaks needed.

Keywords:
Robotics;
Smart Home;
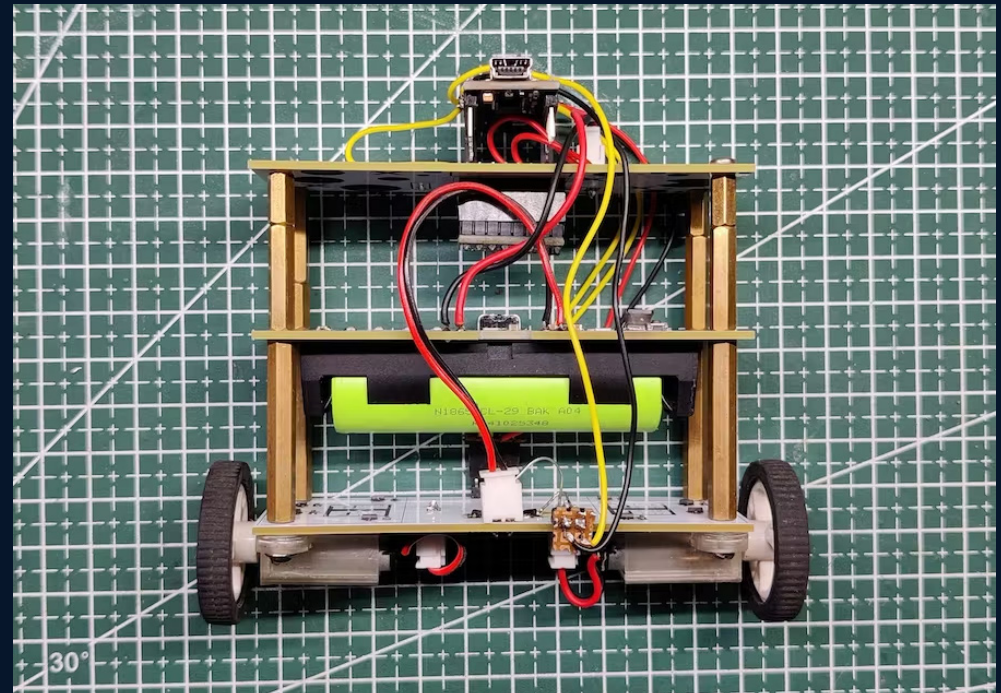
Robotics

A Sumo Style Wrestling League for Hexapod Robots Powered by XIAO ESP32C3

The design is intended to be affordable, with a minimal bill of materials, making it an accessible and easy way to learn about robotics. By building and controlling these hexapods, makers can gain experience in programming, electronics, and mechanical design. The project offers a fun and engaging way to learn these skills, making it an excellent starting point for beginners in robotics.
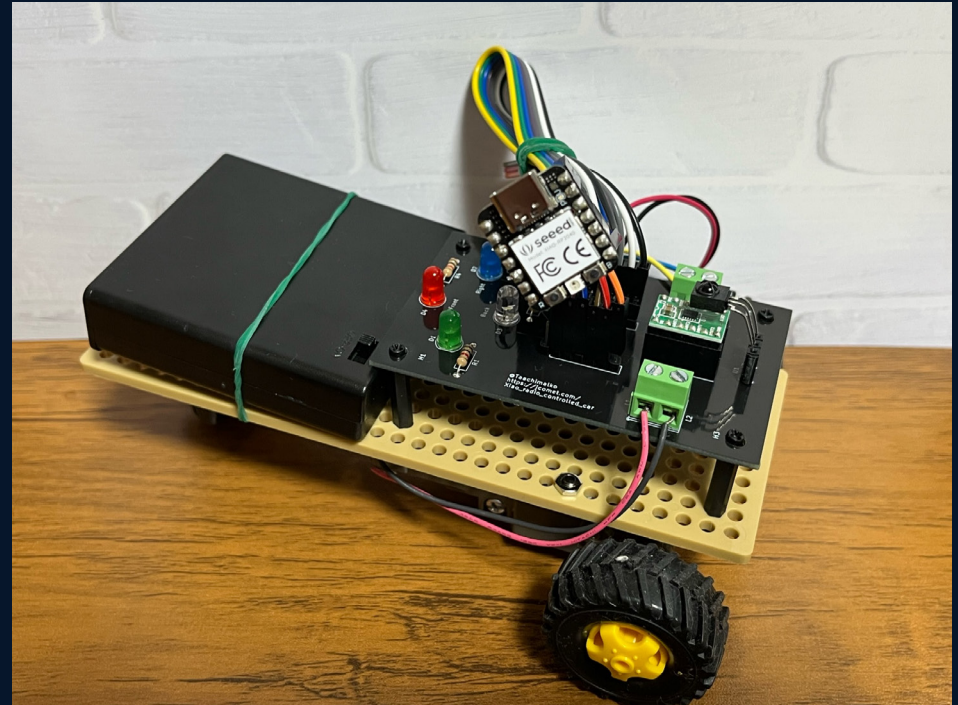
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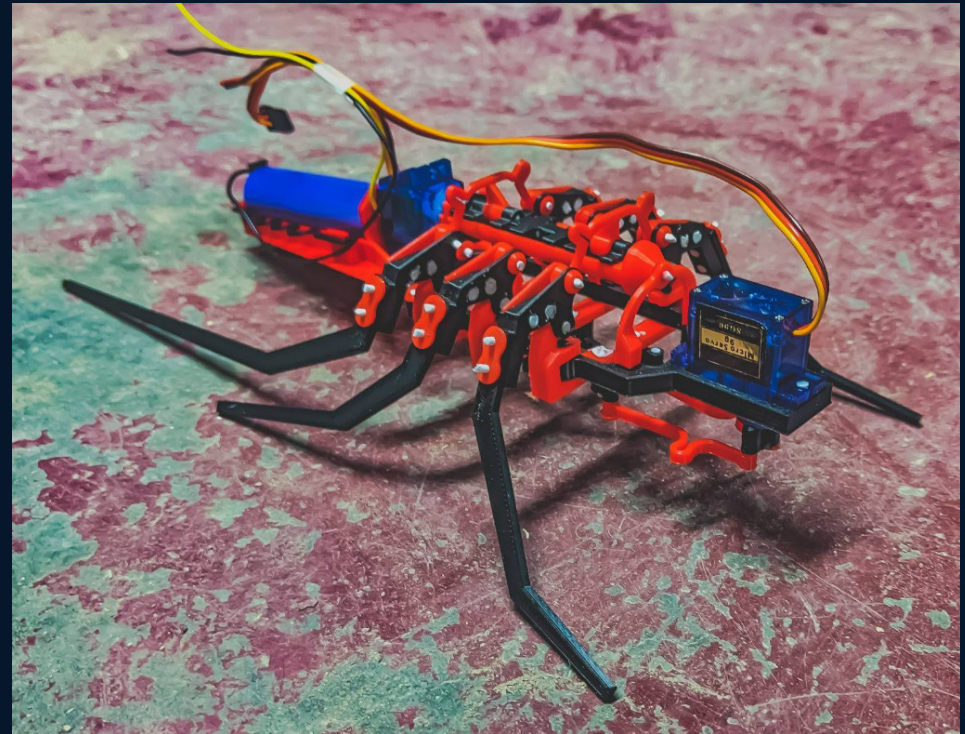
Robotics;

Robotics

Radio-Controlled Cars Powered by XIAO RP2040

The final product was a remote - controlled car that could be controlled from up to 30 meters away using a mobile app and showcased the capabilities of the XIAO RP2040 and Bluetooth technology. The designer aimed to create a compact and efficient PCB that could control the motors and communicate with the mobile app using Bluetooth. He also choses Eagle software to design the PCB and included essential components such as a voltage regulator, motor driver, and Bluetooth module to ensure the car could be controlled wirelessly from a mobile device.

Keywords:

Robotics;

Mechanical Keyboards

ANAVI Macro Pad 12 & Arrows Powered by XIAO RP2040

The Anavi Macro Pad 12 and Arrows is a customizable programmable keypad designed for makers, developers, and anyone who needs quick access to frequently used commands. The Macro Pad 12 features 12 programmable keys, while the Arrows version has four arrow keys and eight programmable keys. Both versions are compatible with various operating systems and can be programmed using the popular QMK firmware. It is easy to assemble and come with pre-soldered components, making them beginner-friendly. They are also open-source and have a modular design, allowing for customization and expansion using various add-ons. The project is currently on Crowd Supply, where backers can pre-order the Macro Pad 12 and Arrows and support the development of open-source hardware.

Keywords:

Mechanical Keyboards;

>> Read More Details
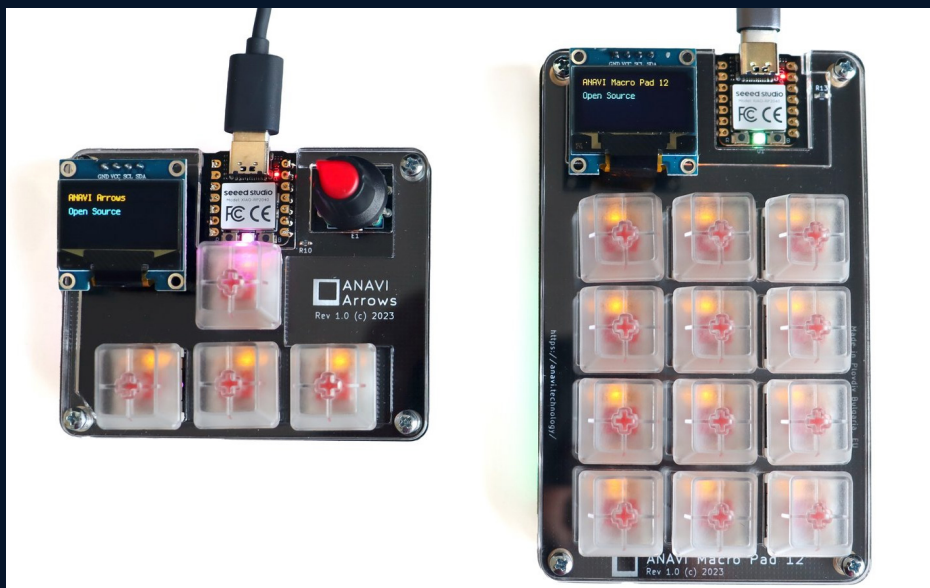
Mechanical Keyboards

TOTEM | a Tiny Splitkeyboard With Splay Powered by XIAO RP2040

The TOTEM is a small, portable split keyboard with a comfortable layout that uses XIAO RP2040 to run wired or wireless. The keyboard features a unique splay design and comes with a custom case. The creator used Ergogen to design the layout, KiCad to create the PCB, and Autodesk Fusion 360 to design the case. The build guide and production files are available for those who want to build their own TOTEM. The keyboard is compatible with QMK and ZMK firmware.
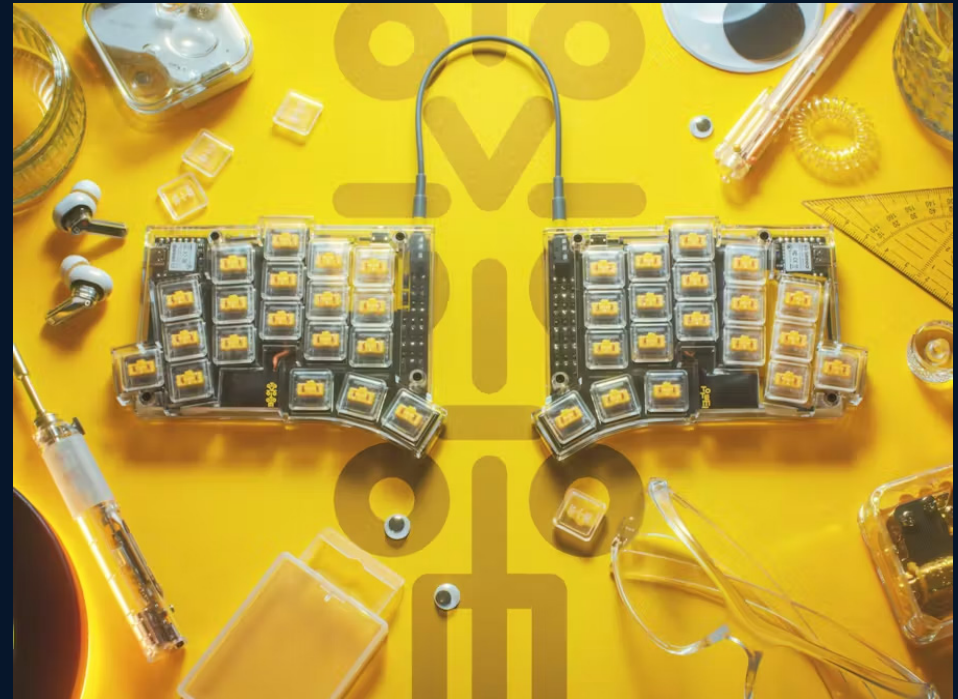
Keywords:
Mechanical Keyboards;

Telecommunication

Ultra Small Ethernet Powered by XIAO RP2040 & WIZNET W5100S

The product designer wanted to design an ultra-small and efficient board by combining the XIAO-series board and the WIZNET W5100S Ethernet chip. The designer had previously worked on projects related to RP2040 and had used the W5100S-EVB-Pico, an Ethernet-enabled board in Pico. However, the designer wanted to create a smaller and more efficient board. The XIAO RP2040 board was chosen due to its compact size while the W5100S chip was selected because of its ability to communicate easily via SPI and provide Ethernet connectivity to the board. The designer wanted to create a board that is suitable for use in embedded systems and IoT devices that require network connectivity while minimizing the size and maximizing efficiency.

Keywords:

IoT;
Industrial Control Systems;

>> Read More Details

Smart Home

DIY Flap Clock Powered by XIAO ESP32C3

The designer attempted to make their own version of a Vestaboard - a flap display - because they found it expensive. The core features of this design are the flap display, which is made up of 64 flaps, and an ESP-based controller that can connect to Wi-Fi for time updates or webpage connections. The design also uses Fusion360 and a 3D printer, and required various supplies such as stepper motors, wires, magnets, screws, a power supply, and wood plates to fix everything. The project had many challenges, especially with the flaps, but the writer was able to make the display partially functional in the end.

Keywords:

Smart Home;
Home Automation;

>> Read More Details

Smart Home

Home Automation Board Powered by XIAO SAMD21

It is a home automation shield for XIAO SAMD21 and provides a compact and versatile platform f or prototyping and building electronic projects. The designer aimed to create a simple shield th at could control various loads using a single SPD T relay, an isolated power supply, and a custom PCB. The shield was designed to be compatible with all XIAO boards, including the XIAO ESP32C 3 and the most recent ESP32S3, making it a pop ular choice among hobbyists, makers, and profe ssionals alike.

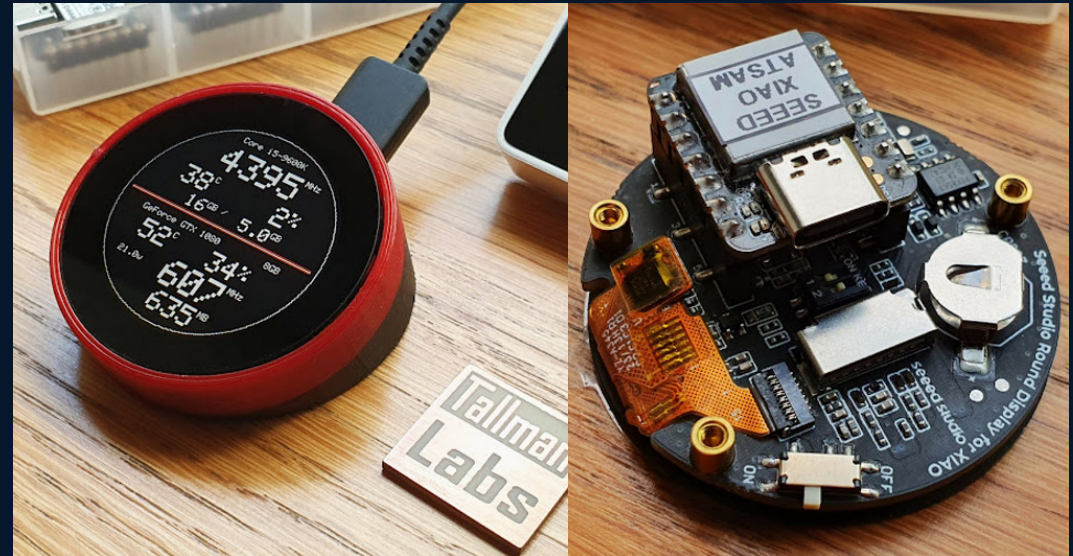### Keywords:
Smart Home;
Home Automation;
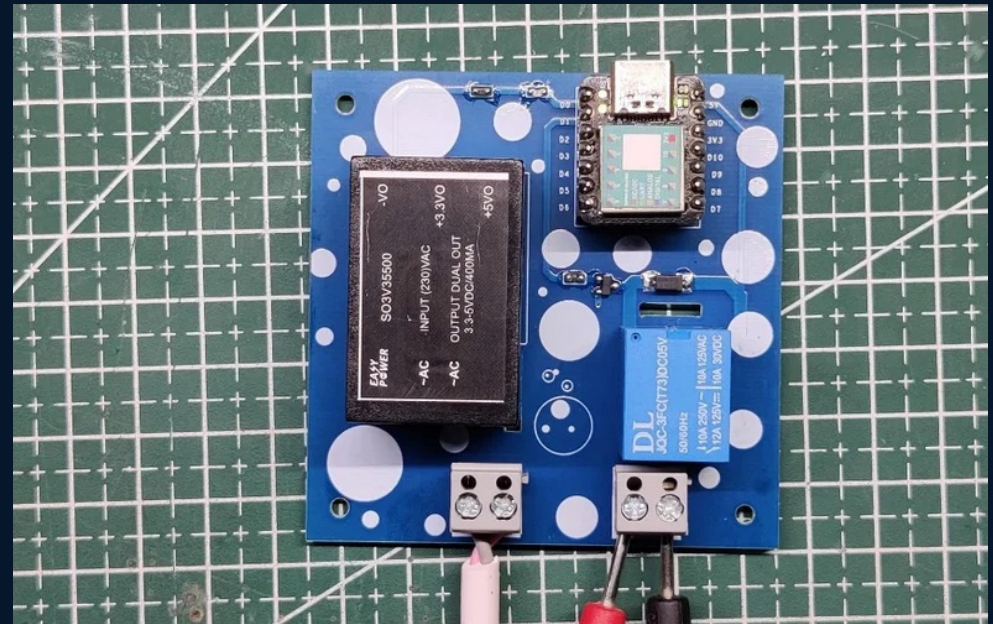
Smart Home

TachoStats PC Hardware Performance Monitor Powered by XIAO SAMD21

It is an efficient and easy-to-use solution for monitoring PC hardware performance. The designer chose to use the [Seeed Studio round display for XIAO](), which features a 1.28" round IPS display and the CST816S I2C capacitive touch controller, to display the performance data. The designer also created a 3D printed enclosure to hold the XIAO microcontroller, providing a compact and elegant solution for the hardware. The designer aimed to make the TachoStats PC hardware performance monitor accessible to anyone who wanted to monitor their PC's performance and provided the Arduino code and STL files for the enclosure on the Tallman Labs Github page.

Keywords:

Smart Home Monitor;
Smart Home Display;

[>> Read More Details]()

Smart Home

PhatStats PC Performance TFT Display Powered by XIAO SAMD21

PhatStats is a PC hardware performance monitor that displays data on an Arduino-compatible XIAO SAMD21 using the Phat-Stats sketch. The HardwareSerialMonitor Windows client reads hardware statistics from a PC's dedicated GPU and forwards the data over a serial port to the XIAO. The project assumes above-average experience with the Arduino IDE and compatible boards. Hook-up guides are available for the Phat-Stats ILI9341 TFT display.

Keywords:

Smart Home Monitor;
Smart Home Display;

Smart Home

SenseCAP Indicator D1Pro Powered by XIAO ESP32S3&RP2040

SenseCAP Indicator is a powerful and versatile IoT development platform that offers a wide range of features and customization options for developers and makers. The platform is equipped with powerful ESP32S3 and RP2040 dual MCUs and over 400 Grove - compatible GPIOs, providing flexible expansion options. It also includes built - kin tVOC and CO_2 sensors and an external Grove AHT20 temperature and humidity sensor for real - time air quality monitoring. The SenseCAP Indicator also features an integrated Semtech SX1262 LoRa® chip for IoT connectivity, allowing users to connect LoRa® devices to popular IoT platforms via WiFi without needing additional compatible devices. Additionally, Seeed Studio provides one top ODM services for quick customization and scale-up to meet various needs.

Keywords:

IoT Development Platform;
Smart Home;

Smart Home

Gas/Smoke Detector, Alarm System With Real - Time Leakage Monitoring Using Seeed Studio's XIAO RP2040

The product designer designed this Gas/Smoke Detector Alarm System with real-time leakage monitoring using Seeed Studio's XIAO RP2040 to provide a compact and reliable safety equipment that can easily be installed anywhere. The designer likely recognized the need for a low-cost, efficient gas/smoke detector that could also provide real-time monitoring and warning in case of an emergency. By using the XIAO RP2040 and MQ-02 gas sensor, the designer was able to create a system that is small, reliable, and easy to use. The designer also utilized the various features of the XIAO RP2040 to provide multiple development interfaces and power supply options, making the system suitable for a wide range of applications.

GAS\SMOKE DETECTOR SYSTEM WITH REAL-TIME LEAKAGE MONITORING

XIAO RP2040

Keywords:

Smart Home;
Smart Factory;

>> Read More Details

TinyML Case Studies

XIAO Series Online Flyer

XIAO Series Getting Started
Wikis/Pin Usage/Feature Usage/Supported Platform

XIAO Series Open Source Materials
(Schematic/KiCAD/Eagle and More!)

Seeed Studio

Seeed Studio XIAO Reference Design

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