

seeed studio

the AI hardware partner

# Beyond Computing new trends in networked sensors

Violet Su  
BOINC Workshop at CERN  
May 2024  
[violet@seeed.cc](mailto:violet@seeed.cc)

```
#INCLUDE <SERIAL.H>
#INCLUDE <RGB_LCD.H>
#INCLUDE <SEEED_FPCB.H>
#INCLUDE <LCD.H>
#INCLUDE <KEYBOARD.H> // ABOVE BUTTONS IN XARROW 2x8
#INCLUDE <KEYBOARD_HACK.H>

VOID SETUP() {
    SERIAL_BEGIN(9600);
    // INITIALIZE RGB_LCD
    LCD_SETBACKLIGHT(0, 0); // SET BACKLIGHT COLOR TO RED
    LCD_PRNT("SEEED STUDIO 10TH ANNIVERSARY");
    // INITIALIZE KEYBOARD
    KEYBOARD_PINMODE(INPUT_PULLUP);
}

VOID LOOP() {
    // READ BUTTON STATE AND DISPLAY ON LCD
    IN_BUTTONSTATE = KEYBOARD_IN();
    LCD_SETBACKLIGHT(0, 0);
    LCD_PRNT("KEYBOARD STATE: ");
    LCD_PRNTIN(IN_BUTTONSTATE, 0, 1);
    LCD_PRNT("10 YEARS WITH SEEED");
    I_ELM(2);
    LCD_CLEAR();
    LCD_SETBACKLIGHT(0, 1);
    LCD_PRNT("SEEED STUDIO ROCKS!");
    LCD_SETBACKLIGHT(0, 2);
    LCD_PRNT("10 YEARS WITH SEEED");
    // WAIT FOR 100 MILLISECONDS BEFORE LOADING AGAIN
    DELAY(100);
}
```

```
#INCLUDE <SERIAL.H>
#INCLUDE <SEEED_SOUND_SENSOR.H>
#INCLUDE <SEEED_RGB_BACKLIGHT.H>
// INITIALIZE SOUND SENSOR
// SEEED_SOUND_SENSOR
// INITIALIZE RGB BACKLIGHT
// SEEED_RGB_BACKLIGHT

VOID SETUP() {
    // INITIATE THE LCD DISPLAY
    LCD_SETBACKLIGHT(0, 0); // SET BACKLIGHT COLOR TO RED
    LCD_PRNT("SEEED STUDIO 10TH ANNIVERSARY");
}

VOID LOOP() {
    LCD_SETBACKLIGHT(0, 1);
    LCD_PRNT("TEMPERATURE = ");
    LCD_SETBACKLIGHT(0, 0);
    LCD_PRNT(TEMPERATURE);
    DELAY(1000);
}
```

```
#INCLUDE <AUDIO.H>
#INCLUDE <SERIAL.H>
#INCLUDE <RGB_LCD.H>
#INCLUDE <SEEED_FPCB.H>
#INCLUDE <LCD.H>
#INCLUDE <KEYBOARD.H> // ABOVE SOUND SENSOR
#INCLUDE <KEYBOARD_HACK.H>

VOID SETUP() {
    SERIAL_BEGIN(9600);
    // INITIALIZE LCD
    LCD_SETBACKLIGHT(0, 255); // SEEED STUDIO 10TH ANNIVERSARY BLUE COLOR
    // INITIALIZE TEMPERATURE SENSOR
    TEMP_SENSOR_BEGIN();
}

VOID LOOP() {
    LCD_BRIGHT(1);
    LCD_SETBACKLIGHT(0, 0); // ROTATE THE LCD DISPLAY
    LCD_SETBACKLIGHT(0, 0); // SET BACKLIGHT COLOR TO RED
    LCD_PRNT("SEEED STUDIO 10TH ANNIVERSARY");
}

VOID KEYUP() {
    // READ AND CONVERT TEMPERATURE FROM SENSOR
    // TEMPERATURE = (TEMPERATURE * 1.0 - 0.5) / 400 // CONVERT TEMPERATURE FROM CELSIUS TO FAHRENHEIT
    // // FROM TEMPERATURE TO SERIAL OUTPUT
    // // SERIAL_PRNT(TEMPERATURE);
    // SERIAL_PRNT(TEMPERATURE);
    // SERIAL_PRNT(TEMPERATURE);
}

// DISPLAY TEMPERATURE ON LCD
LCD_PRNT("TEMPERATURE = ");
LCD_PRNT(TEMPERATURE);
LCD_PRNT("10TH ANNIVERSARY");
LCD_PRNT("TEMPERATURE");
LCD_PRNT("10TH ANNIVERSARY");
LCD_PRNT("10TH ANNIVERSARY");

// WAIT FOR A SECOND BEFORE A OPEN A NEW SHOT
DELAY(1000);
}
```

```
#INCLUDE <SERIAL.H>
#INCLUDE <SERIAL_SOUND_SENSOR.H>
#INCLUDE <SEEED_RGB_BACKLIGHT.H>
// INITIALIZE SOUND SENSOR
// SEEED_SOUND_SENSOR
// INITIALIZE RGB BACKLIGHT
// SEEED_RGB_BACKLIGHT

VOID SETUP() {
    // INITIATE THE LCD DISPLAY
    LCD_SETBACKLIGHT(0, 0); // SET BACKLIGHT COLOR TO RED
    LCD_PRNT("SEEED STUDIO 10TH ANNIVERSARY");
}

VOID LOOP() {
    LCD_SETBACKLIGHT(0, 1);
    LCD_PRNT("SOUND INTENSITY = ");
    LCD_SETBACKLIGHT(0, 0);
    LCD_PRNT(SOUNDINTENSITY);
    DELAY(1000);
}
```

# About us

seed studio  
the AI hardware partner

Seed Studio has been a leading Open Hardware company **since 2008**, empowering half a million direct users to create real-world digital solutions. Through relentless efforts and earned trust, our ever-growing product lines now form around emerging AI scenarios:

- **Sensor networks to fetch extensive real-time data**
- **Edge computing to push intelligence to new frontiers**



**Smart Sensors**

- Collect data -



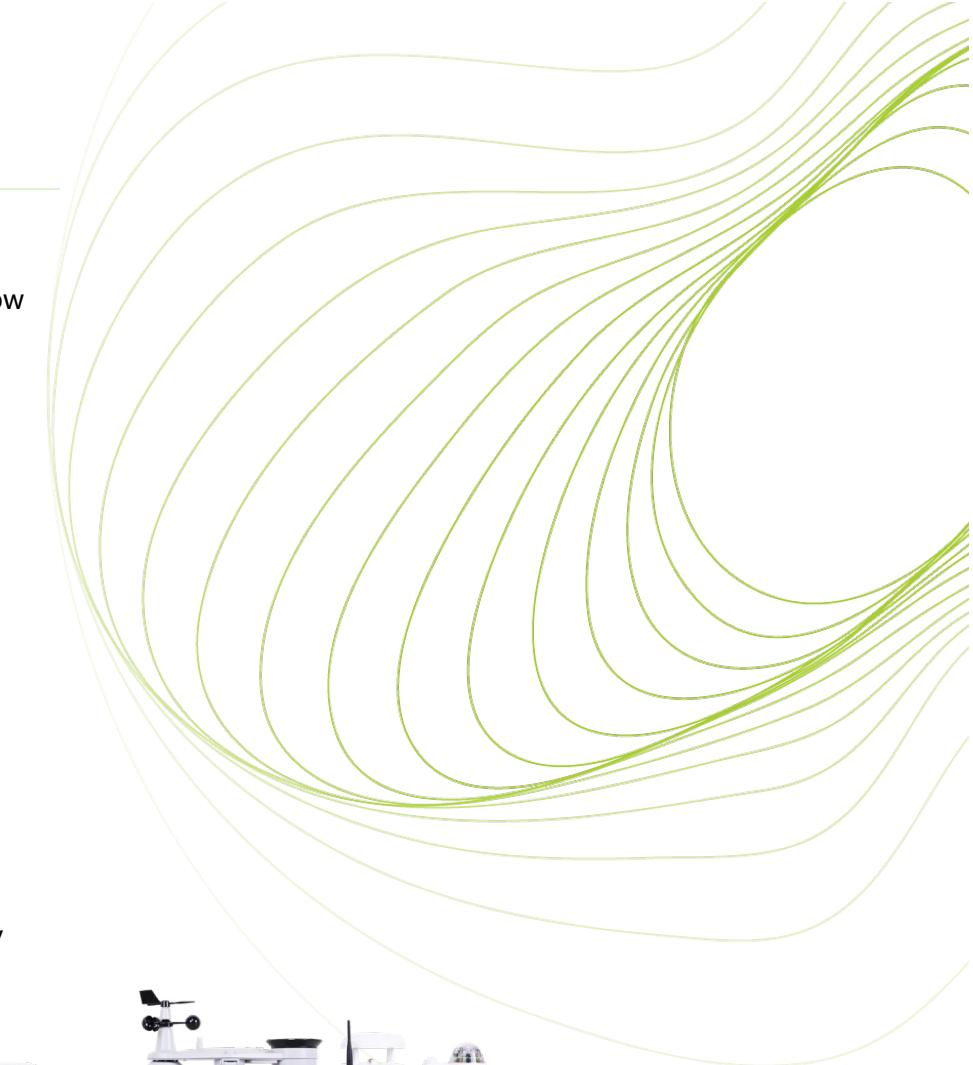
**Long-range Network**

- Move data -



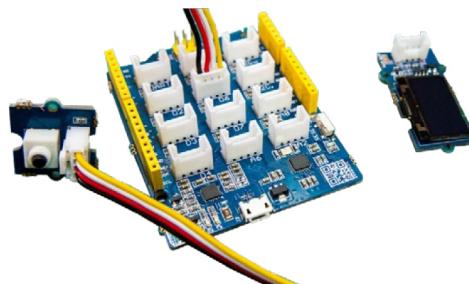
**Edge computing**

- Process data -



We provide **industrial-ready modules and devices**, and open up the capability of **prototype, produce, and promote** as Fusion service. Innovators from different vertical domains co-create with us to make their creations widely available for diversified markets.

By embracing open source, community building and integrated software suites like SenseCraft, we are proactively lowering the tech barriers and including users with diverse expertise for glocalized matters.



How it started in 2008

From possibilities to productivities



How it's going in 2024

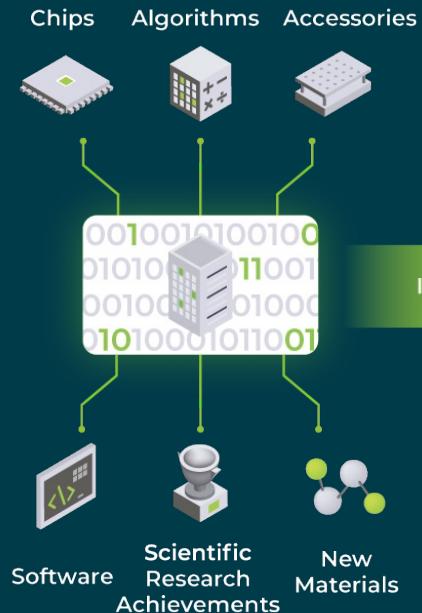
## From Technology to Industry



### Technologies

- Open Source Hardware
- Machine Learning
- Advanced Sensors
- Home Assistant
- Wireless, DePIN
- LLM

### Emerging Technologies



### Applications

- Asset Tracking
- Smart Building
- Industrial space
- Smart City
- Smart Agriculture
- Smart Energy
- Tech for good
- Open Science

### Digital Economy



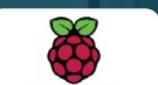
Beaglebone



Home Assistant



NVIDIA® Jetson



Raspberry Pi



SenseCAP



TinyML

# Sensor Network

fetch extensive real-time data from physical world

Seeed Studio provides customers with smart sensing and network coverage capabilities.

- Low-power + efficient + intelligent
- Ready to use devices + easy to develop open source modules

## Devices

### AI Sensors

Smarter sensors, to see, to hear, to understand



### LoRaWAN Devices

Low power, long range  
Low connectivity cost



### Weather Sensors

All-in-one with multi parameter  
Easy to integrate



## Modules

### XIAO tinyML MCUs



10+

Arduino, ESP32, tinyML,  
Diverse connectivities

### Sensor and peripheral modules

### Grove Open Source Plug & Play Modules



400+

Vision, environmental sensors, actuators,  
Various kits with rich tutorials

### Wio Communication Modules



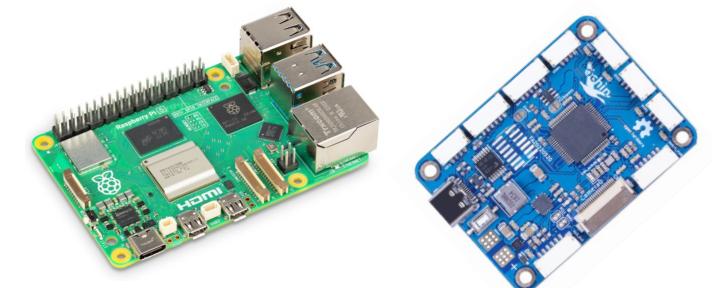
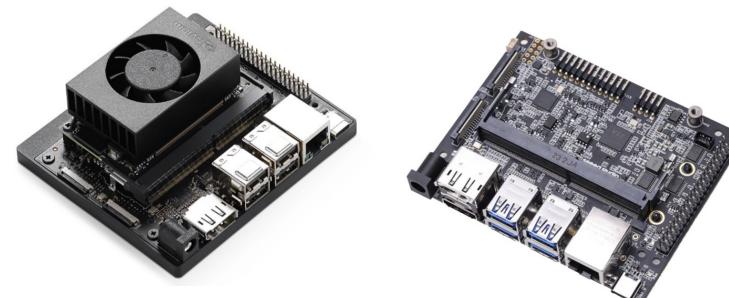
Low-cost LoRa modules for sensor & gateway

# Edge Computing

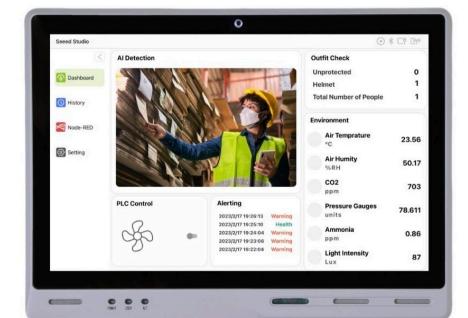
push intelligence to new frontiers

Seeed Studio offers a wide range of edge computing options, from development boards to industrial-grade devices.

- **SBCs & accessories for developers**



- **Robust devices for industries**



# SenseCraft

Automate device deployment and MLOps in the field

## SenseCraft Edge Builder



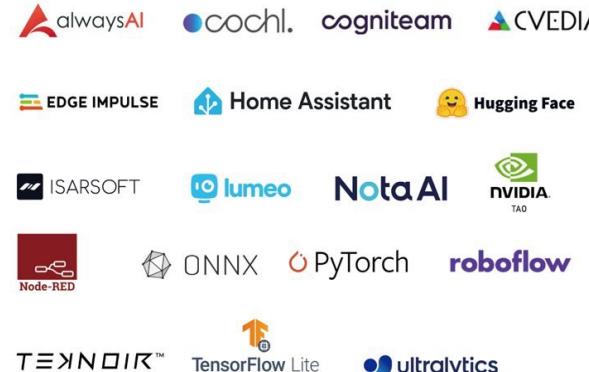
LoRaWAN | 2G / 4G |  
Bluetooth | Wi-Fi4G

## SenseCraft Node Builder



## Firmware Payloads

### Edge AI



### DePIN



### Open Source Projects



## SenseCraft

### Mobile App / Web toolkit

- Enable 3 steps quick configuration and easy deployment. No code, No touch, No complexity.
- Fleet management.
- Secure device up to date, not just on the cloud, but also at edge locations.
- Flexible API.
- On-premise deployment support. Remote data access, visualization.

### SenseCraft Model Assistant

- 3 steps to deploy AI models to devices.
- Build active community and model sharing mechanisms to maximize the value of models.
- Offline available, ensuring data privacy and security.



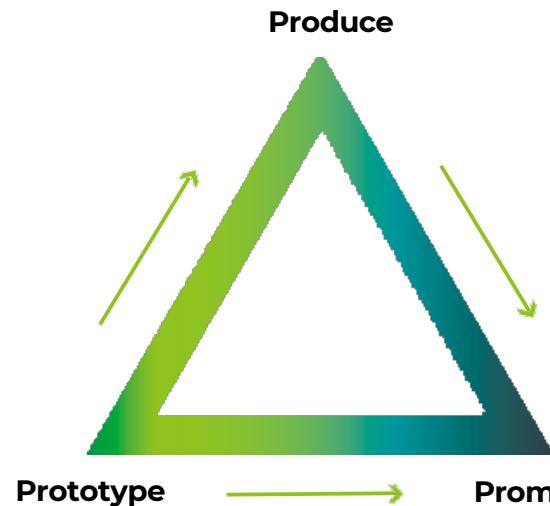
# Co-Create with Seeed Fusion

Fast Track from Idea to Market

Seeed Fusion: One-stop services catering to your needs:

**Design & customization => production => promotion.**

## Open Source + AI + Hardware



### Prototype - Design and Customization for Diverse Needs



Full spectrum services - from light to deep customization

Open reference design - lower threshold for rapid prototyping

Professional expertise - proven product design experience

### Produce - From Small-batch to Mass Production



Instant online quotation & lead time for PCB & PCBA

Professional experts - guaranteed services for scale-up

Designated engineers & professional project management

### Promote - Rich Resources for Marketing and Promotion



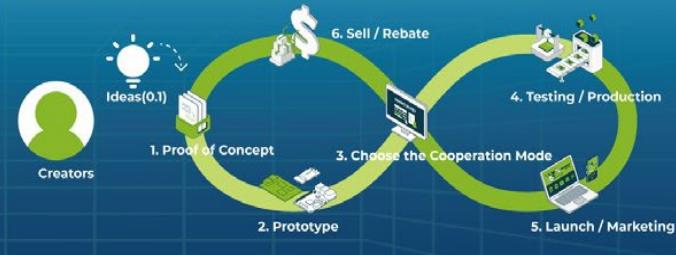
Online store serving half a million direct customers worldwide

200+ global and local distributors via online/offline channels

Dedicated resources to create contents with active communities

**Co-create and launch  
your ideas with Seeed Studio**

The easiest way to amplify on your ideas and talents



## Fusion Co-Create Success Cases



### Demo Badge for AWS IoT

IoT educational platform



### ESPressoscope

Platform for in situ microscopy



### Ochin CM4

Carrier board for RPI CM4



### Smart Citizen

Environmental monitoring



### Crazyflie

Micro palm-size quadcopter



### Loko GPS Tracker

Tiny LoRaWAN GPS Tracker

# Growing Partnerships

arm

SENSIRION  
THE SENSOR COMPANY**Chip providers**  
**30+****Embedded SW**  
**15+**

allxon

**ML / CV**  
**20+**

Microsoft

**Cloud & Network**  
**40+****Community**



**“Leave No One Behind”**

- Motto of the UN 2030 Agenda for Sustainable Development

**“Empower Everyone to Achieve Their Digital Transformation Goals”**

- Mission Statement of Seeed Studio

# Tech for SDG

## Smart Citizen

Deployed in: USA, Mexico, Brazil, Argentina, Chile, Puerto Rico, Colombia and more.

An open source hardware and software platform that enables local citizens to collect data in urban areas. This project contributes to SDG 3, 4, 5, 6, 9, 10, 11, 12, 13, 16, and 17.

## FarmBeats for Student Program

Deployed in: Global  
 This program is to facilitate technological empowerment of young people to learn about AI, Machine learning, and IoT in agriculture. . This project contributes to SDG 2, 10, 4, 1, 5, 9, 8, 6, 7, 12, 11, 13 and 17.

## Smart Black Soldier Fly Farming

Deployed in: Tanzania  
 A resource-efficient and low-cost protein production method by monitoring and optimizing BSFs' living environment.  
 This project contributes to SDG 1, 2, 9, 11, 12, 13, 15, and 17.



## Code Jumper Kit

Deployed in: USA, Canada, Australia, UK, India  
 Innovative educational tool designed for students with visual difficulties to enhance their computer coding and programming skills. This project contributes to SDG 1, 4, 5, 8, 9, 10, 16, and 17.

## Marine Litter Detective

Deployed in: Hong Kong  
 A GPS-tracking device for monitoring marine pollutants, such as plastics and oil spills. This project contributes to SDG 3, 4, 6, 9, 11, 12, 13, 14, 16, and 17.

## Animal Behavior Analysis & Habit Pattern Tracking

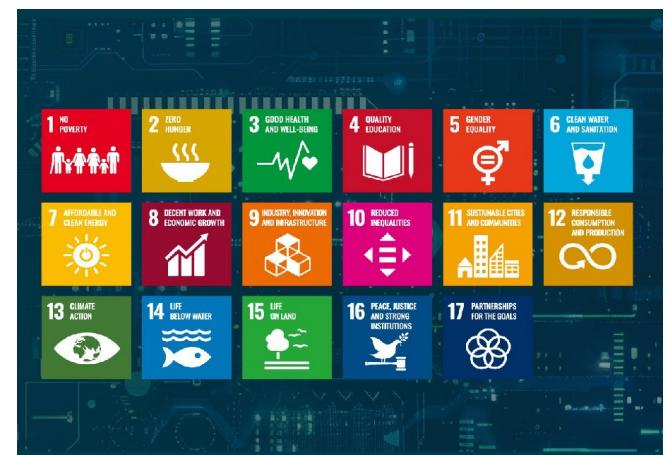
Deployed in: US, Australia  
 Leverages computer vision AI models to optimize zoo management, identify and tracks animals within their enclosures. This project contributes to SDG 9, 11, 13, 15, and 17.

## Carbon Sequestration Monitoring

Deployed in: Liberia  
 Monitor climate and greenhouse gas data in rainforests for climate research. This project contributes to SDG 4, 9, 11, 13, 15, and 17.

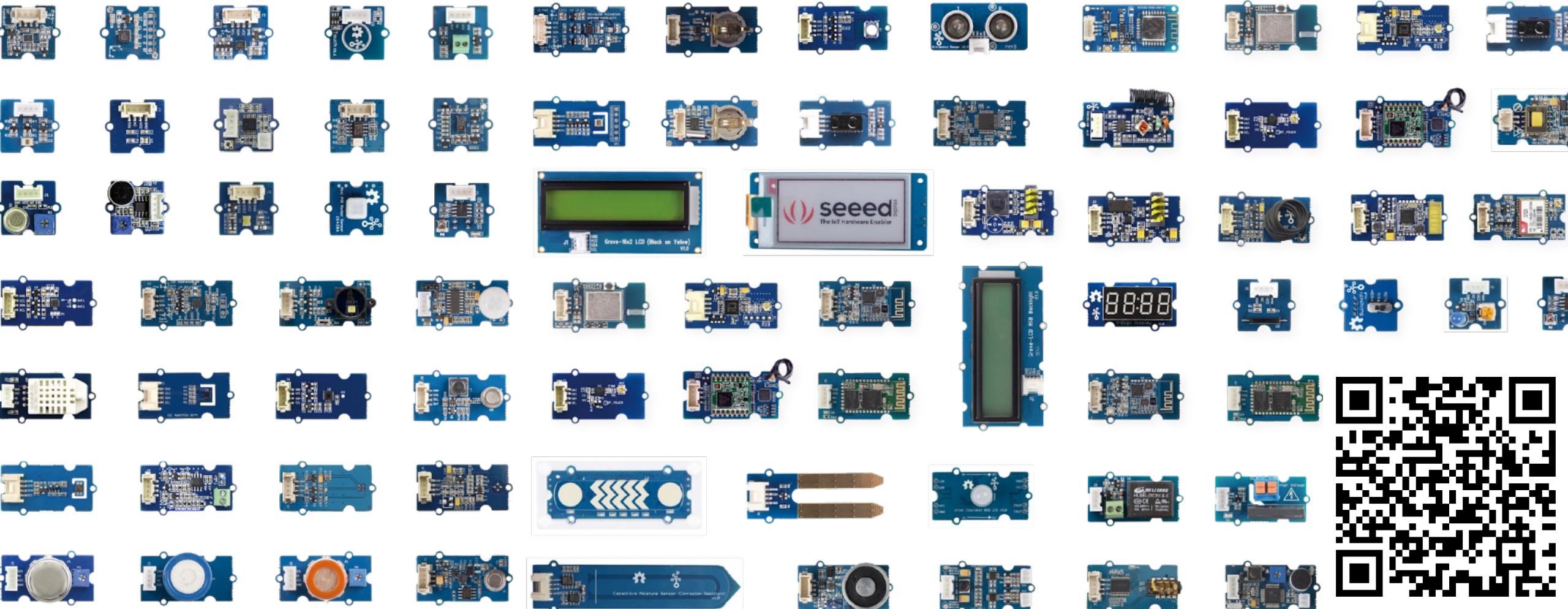
## Protei - Open Source Ocean Cleaning Robot

Deployed in: Global  
 This is a wind-powered and automated sailing fleet robot designed to resolve the world's oil spill issues caused by the Deepwater Horizon Disaster in the Gulf of Mexico. This project contributes to SDG 6, 14, 11, 15, 3, 1, 7, 9, 8, 12, 13 and 17.



# Atlas of Sensors

Nerve endings of the digital world



Scan code to  
download

## SenseCAP ONE Weather Sensors

Compact all-in-one weather sensors measure multiple parameters



	SKU	Air Temperature	Humidity	Air Pressure	Light Intensity	Wind Speed	Wind Direction	Rainfall	PM2.5	PM10	CO <sub>2</sub>	Noise	Radiation
S1000	101991024	●	●	●	●	●	●	●	●	●	●	/	/
S800	101991023	●	●	●	/	●	●	/	●	●	/	●	/
S700/ S700-A	101991022	●	●	●	●	●	●	●	/	/	/	/	/
S700-B	101991102	●	●	●	/	●	●	●	/	/	/	/	●
S500	101991021	●	●	●	/	●	●	/	/	/	/	/	/
S200	101991044	/	/	/	/	●	●	/	/	/	/	/	/

Get the Weather Data via SenseCAP Data Logger

- Data transmit via LoRa Network



- Data transmit via Cellular(4G/3G/2G) Network



seeed studio

# Adding AI to almost anything

## ① multi-modal

vision  
sound  
speech  
sensors

## ② faster

new architecture  
(Cortex-M55)

## ③ low power

<1 w

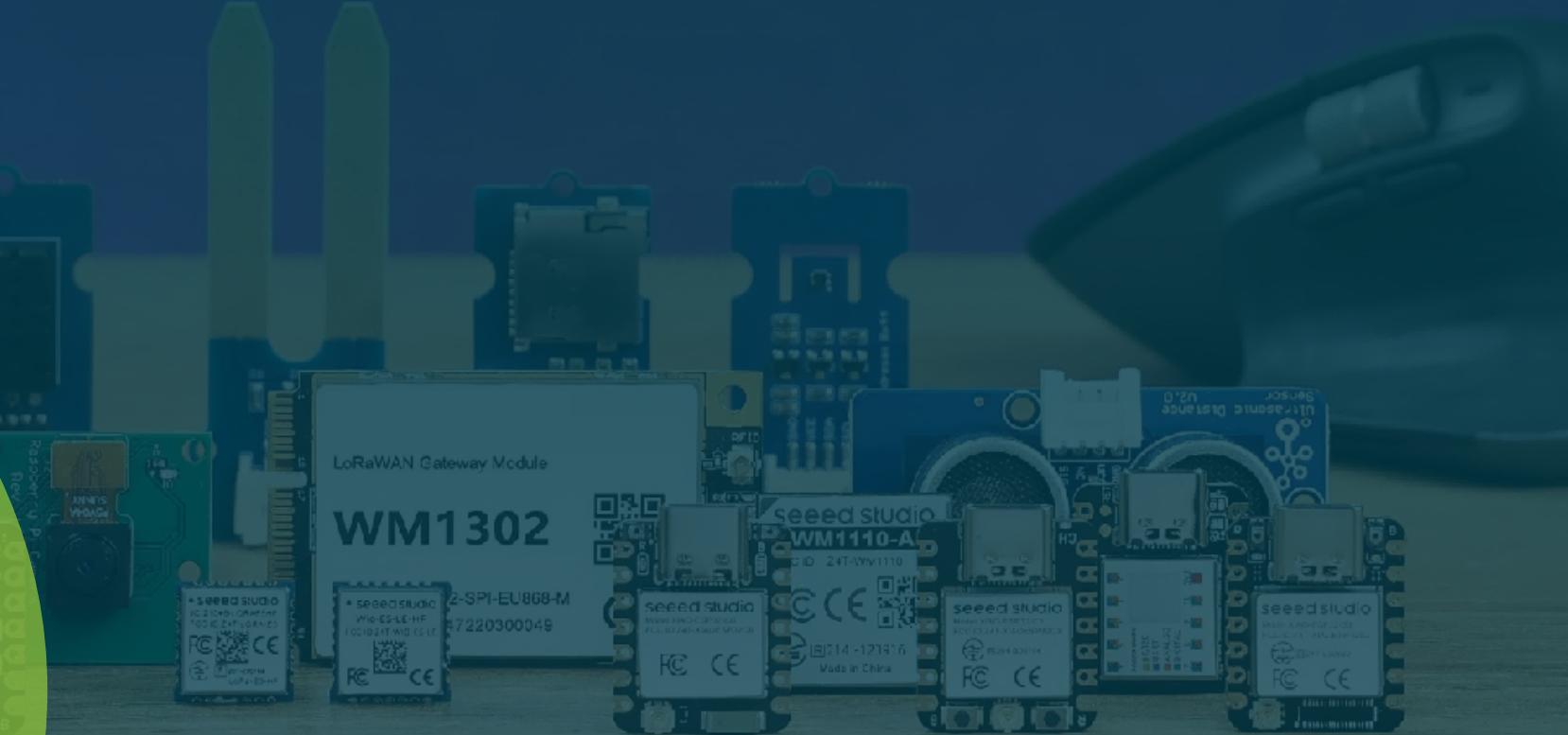
# TinyML

## ④ easier

few shot  
training  
no-code  
web server

## ⑤ cheaper

<10 \$



## XIAO - tinyML MCUs Add AI to Almost Everything

The Seeed Studio XIAO Series is a collection of thumb-sized, powerful microcontroller units (MCUs) tailor-made for space-conscious projects requiring high performance and wireless connectivity.

Supporting ESP32, RP2040, nRF52840, and SAMD21, the Arduino compatible XIAO series is the perfect toolset for you to embrace tiny machine learning (tinyML) on the Edge. Trusted by 500,000 developers globally!



- **Module and Development Board Hybrid**

Perfect for rapid prototyping



- **Unified form factor**

Easy integration for product design



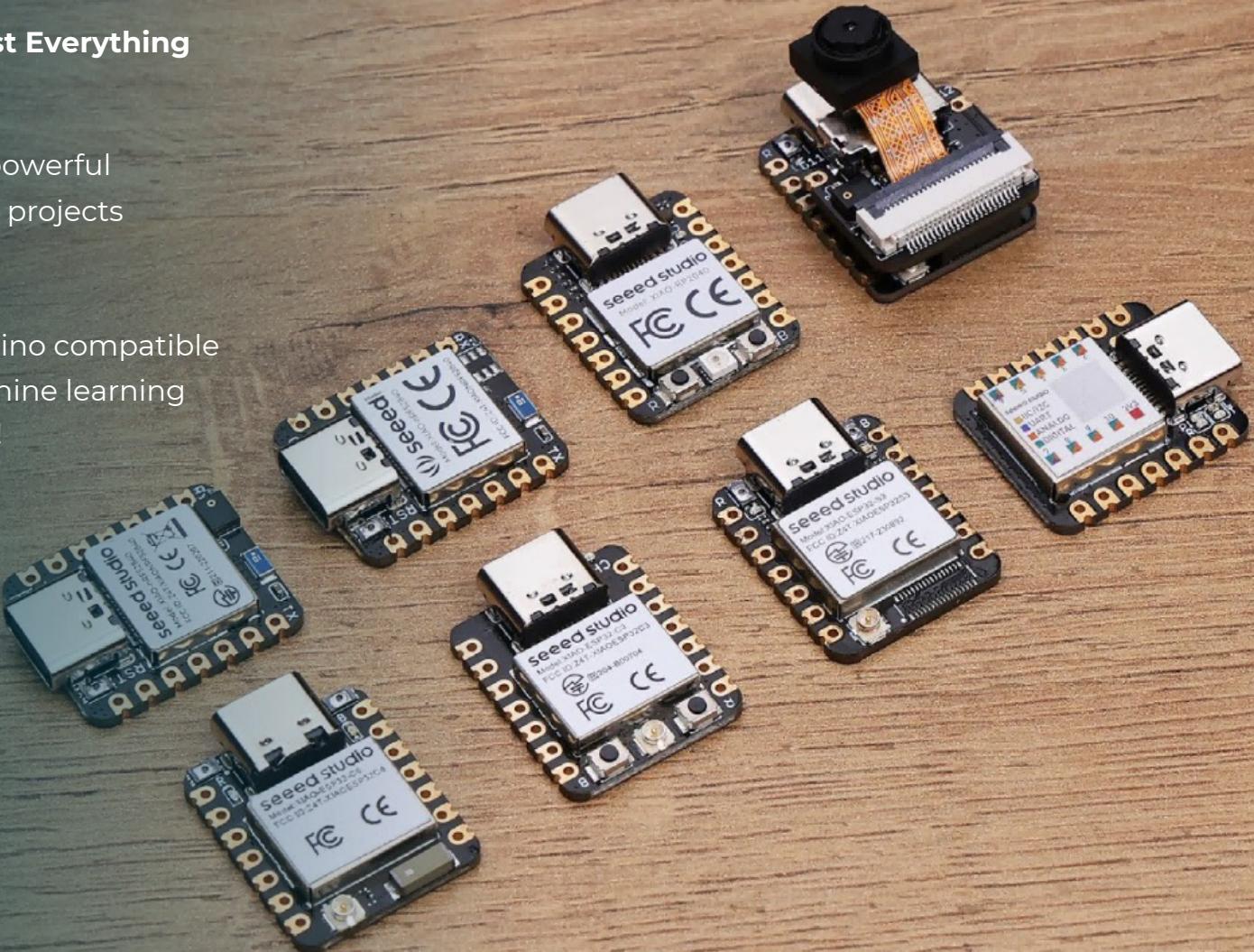
- **Single-Sided Surface Mount Design**

Streamline production process



- **Strong Ecosystem Support**

Extendable for iteration of your projects



# Easier - No code model MLOps

## SenseCraft Model Assistant

It is an AI platform dedicated to simplifying the training, distribution, and deployment of AI models.

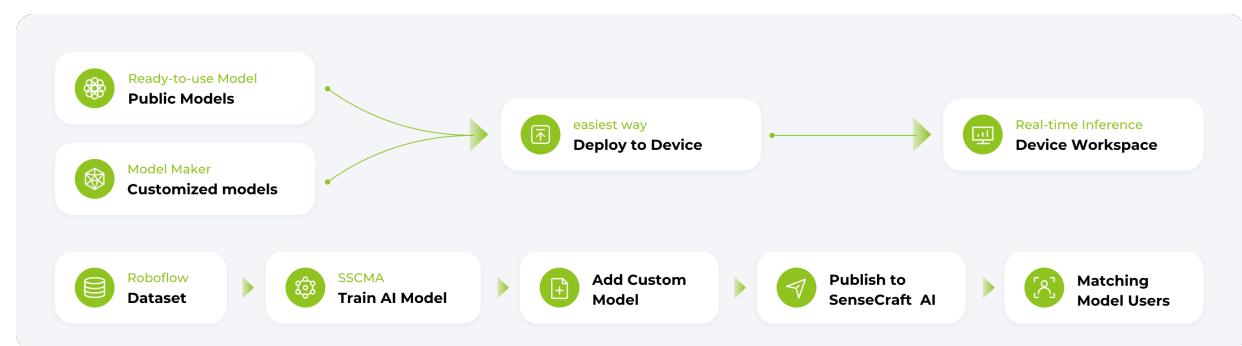
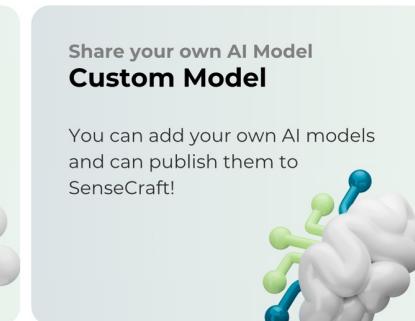
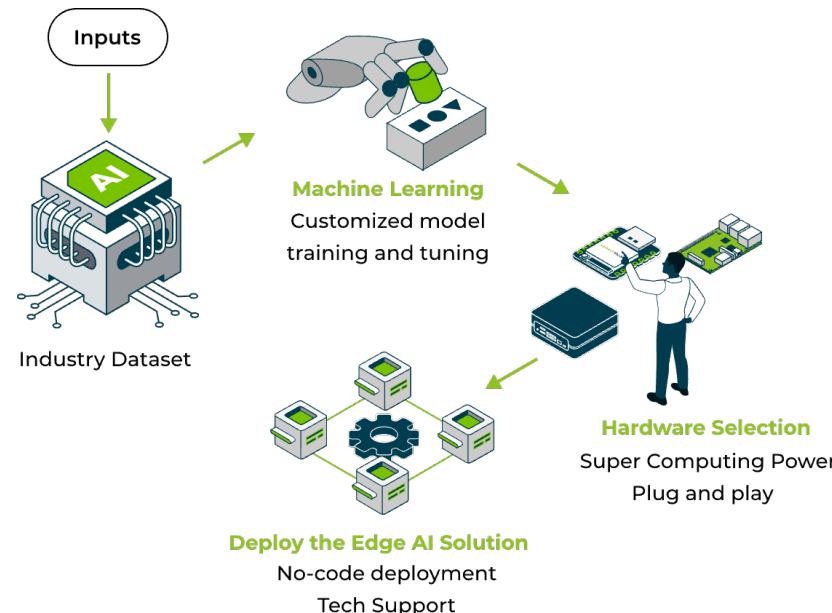
Enable high-speed and accurate inference on low-cost hardware, unlocking the powerful potential of AI in edge devices.

Just a few clicks => deploy models (~~configuration and coding~~).

- ✓ Current computer vision algorithms: target detection, image classification, image segmentation, and pose) & LLMs

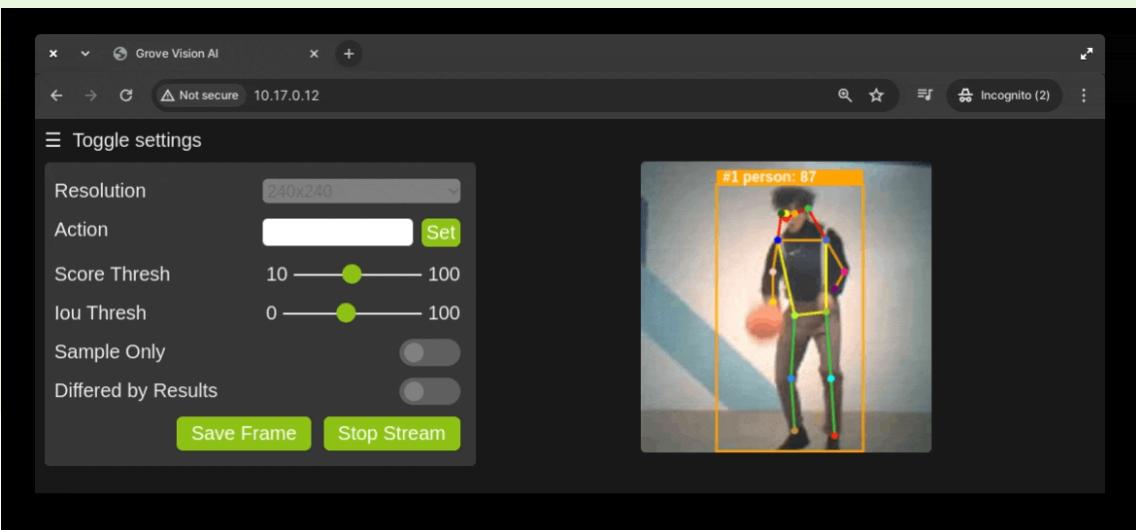
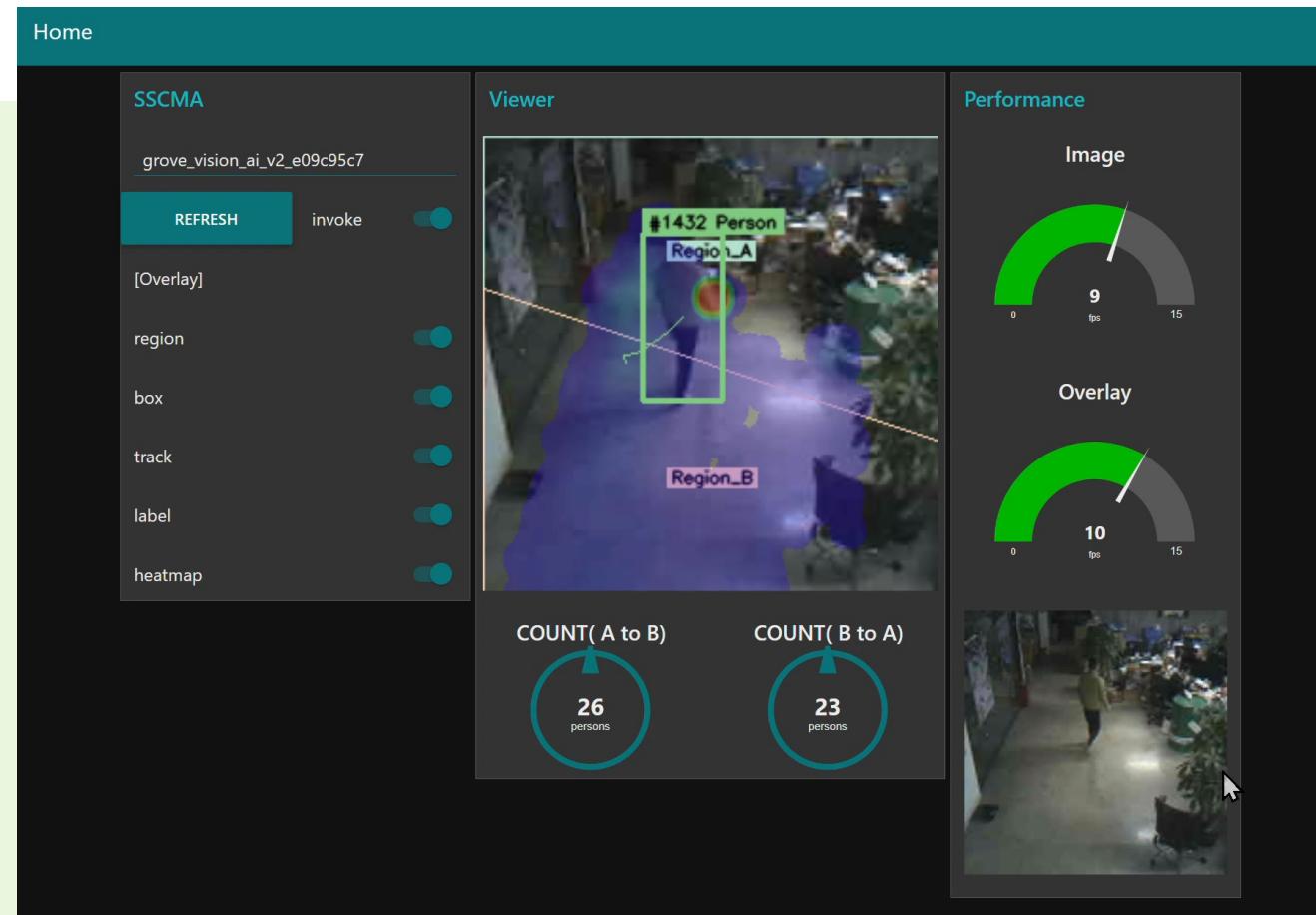
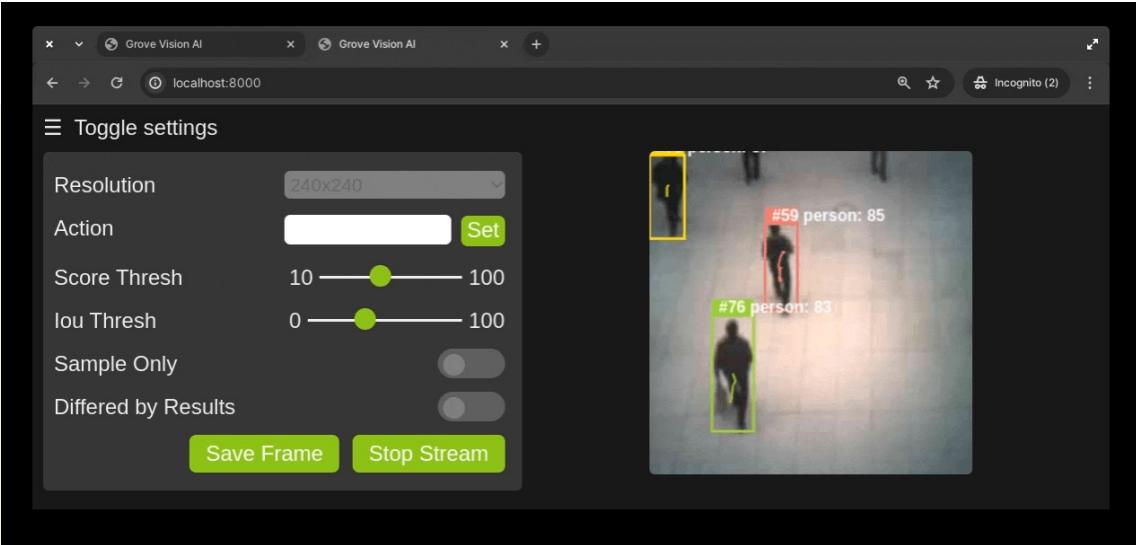
Support users to

- ✓ upload and share self-trained models,
- ✓ build a shared model library,
- ✓ promote collaboration and innovation among AI enthusiasts.



# Easier - No code model MLOps

seeed studio

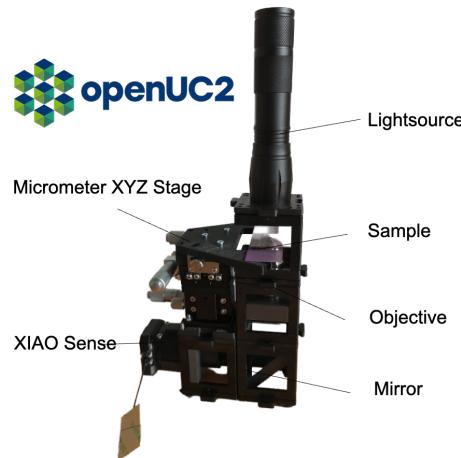
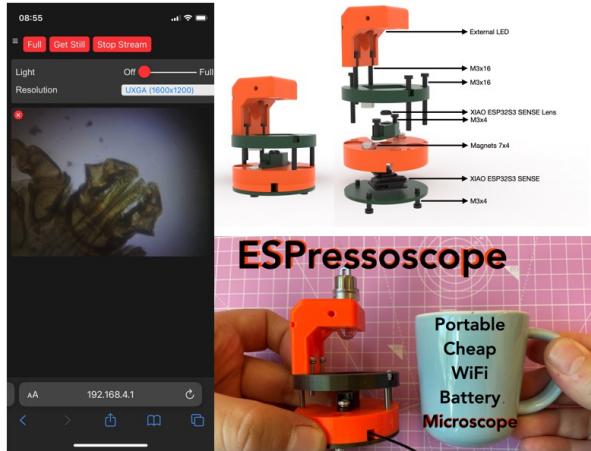


# Easier - chat with TinyML

# seed studio

The image is a screenshot of a messaging application interface. On the left, there is a list of messages from a bot named "Vision AI V2". Each message is a dark grey box containing white text. The messages all read "Message from Vision AI" followed by "Alert: Human presence detected. Check the area." and a timestamp of "12:29 PM". There are seven such messages stacked vertically. At the bottom of this list is a dark grey footer bar with three icons: a smiley face for "Message", a green speech bubble for "Media", and a microphone for "Voice". To the right of the message list is a vertical sidebar titled "Bot Info". It features a small circular profile picture of a man with short brown hair. Below the profile picture, the bot's name "Vision AI V2" and its status "bot" are displayed. Underneath this, there are two settings: "@ RoomCamBot Username" and "Notifications", which is currently turned on as indicated by a blue toggle switch. At the very bottom of the sidebar, there are five tabs labeled "Media", "Files", "Links", "Music", and "Voice", with "Media" being the active tab. In the bottom right corner of the entire interface, there is a small text message "No media files yet".

# OpenUC2 – Open-source, modular optical platform

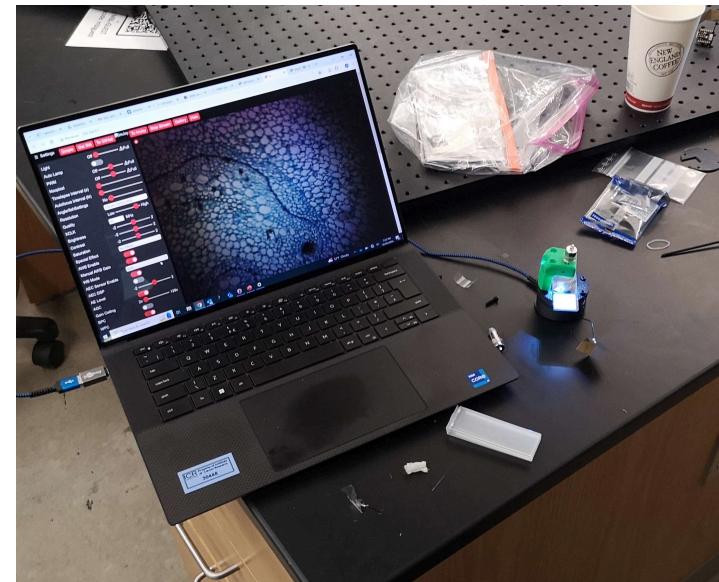
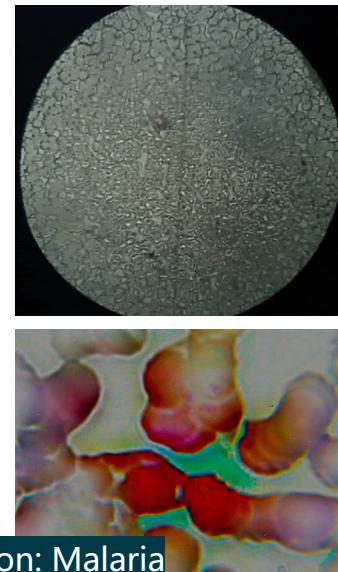


OpenUC2 provides open source modular microscopy toolboxes for biology, chemistry, physics etc. for education and researches.

- Decentralized data collection for citizen science
- Edge AI processing the data
- High resolution
- Low-cost
- Open source



Open-Source Hardware for Global Disease Detection: Malaria



Available soon!

# Urban Heat Island Mitigation in Cagliari, Italy

seeed studio

**Location:** Cagliari, Italy (300+ sites in 30+ zones)

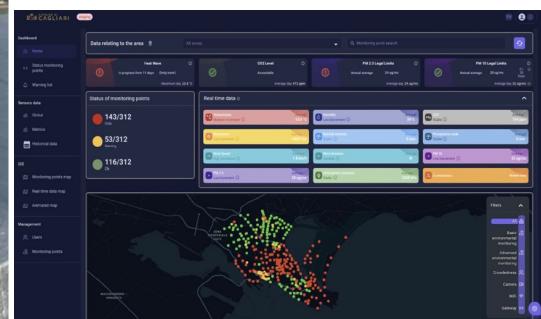
**Specific Scenario:** Smart City Heat Island Monitoring

- **Parameters:**

- **Crowdness via WiFi sniffers**
- **Micro-climate data via weather stations:** air temperature, air humidity, wind speed, wind direction, rain fall, PM2.5, PM10, CO2, barometric pressure, light intensity

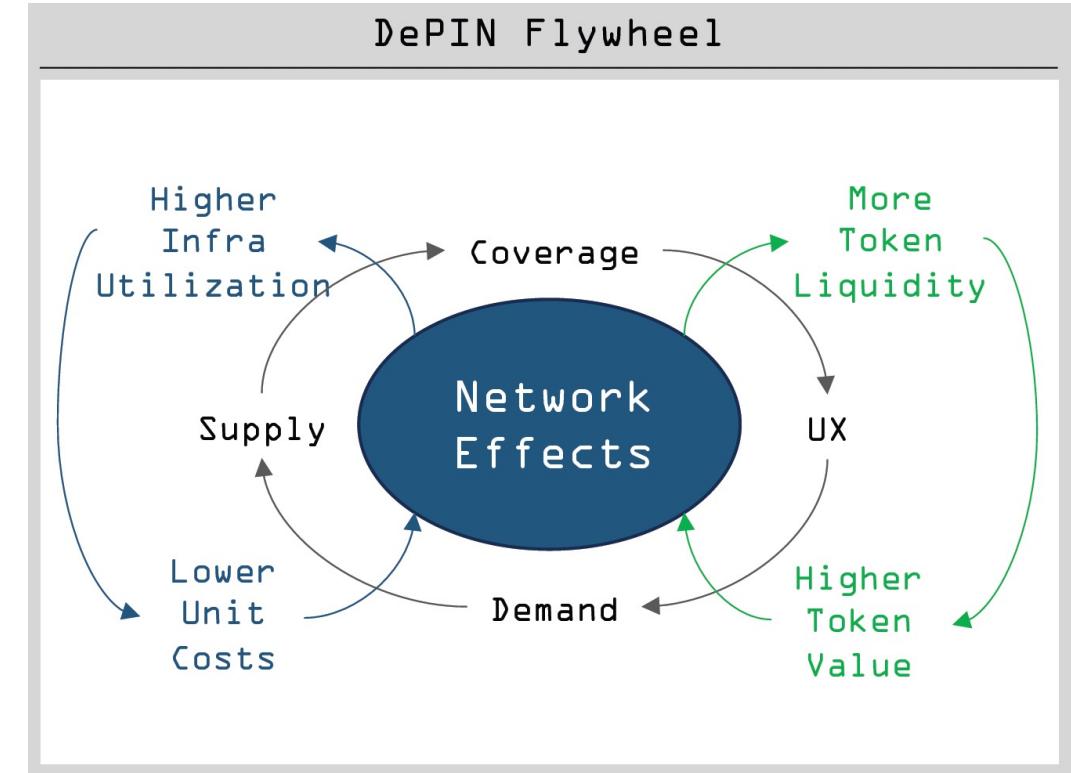
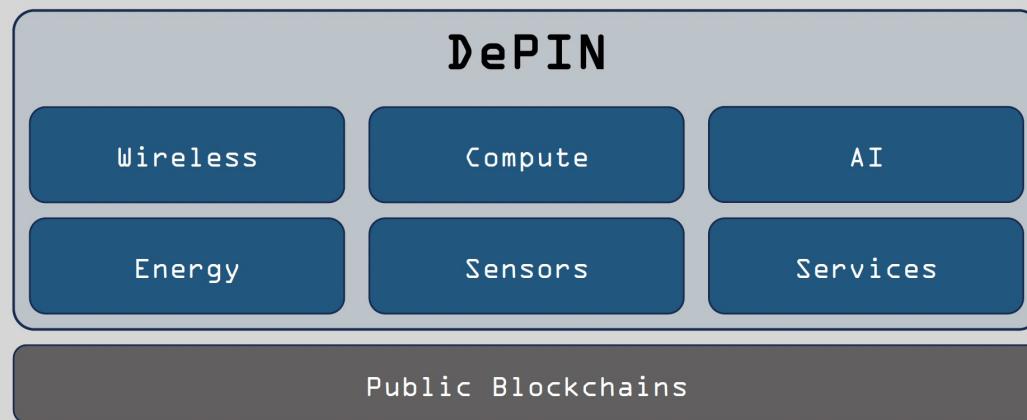
## Values/Results created

- ✓ Identify & monitor urban heat islands
- ✓ Create more green areas
- ✓ Enforce light color of building facades
- ✓ Study and build urban heat island mitigation systems
- ✓ Build AI models to predict future heat waves and air quality
- ✓ Optimize services for smart cities



DePIN = decentralized physical infrastructure networks.

Networks that use crypto-incentives to efficiently coordinate the buildup & operation of critical infrastructure.



# The reliable hardware partner to boost DePIN projects

seeed studio

## Decentralized Sensors



weather network



LoRaWAN WXM  
Weather Station



IoT Platform



DePIN Dev Kit

## Decentralized Networks



LoRaWAN Network

~200K



SenseCAP M1

SenseCAP M2



SenseCAP M4



VPN Network



SenseCAP M1

SenseCAP M4

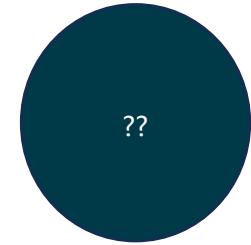
## Decentralized Compute



Cloud Network



SenseCAP M4



More to come!

## Hardware & Software Suite

- Reliable
- Robust
- Plug & play
- Easy-to-use
- Scalable
- Multiple-in-one

## Powered By SenseCAP Software Suite



Web3 dApps Center



SenseCAP Hotspot App/Dashboard



SenseCraft Device Management

# Network - Decentralized LoRaWAN Network

seeed studio



By deploying a Helium Hotspot in your home, office, or elsewhere in the wild, you can provide your town with wireless network coverage and earn Helium tokens.

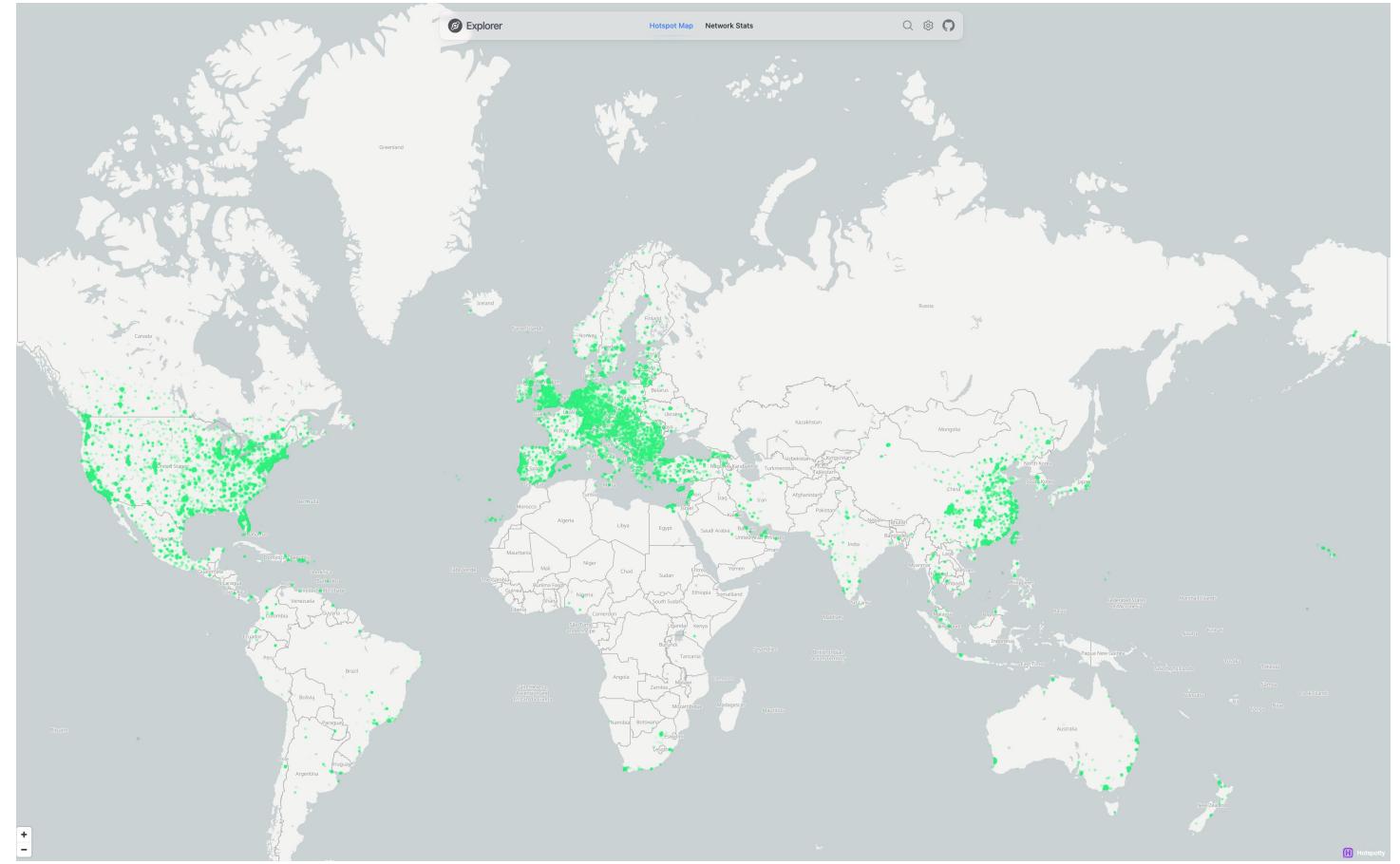
## Rewards

- PoC – proof of coverage
- Package forwarding

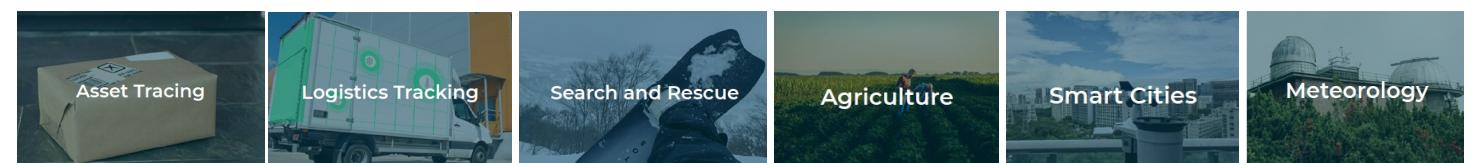
## SenseCAP LoRaWAN hotspots & end nodes



Credits & learn more: <https://www.helium.com>



## Applications



# Sensor - Decentralized Weather Network

seeed studio

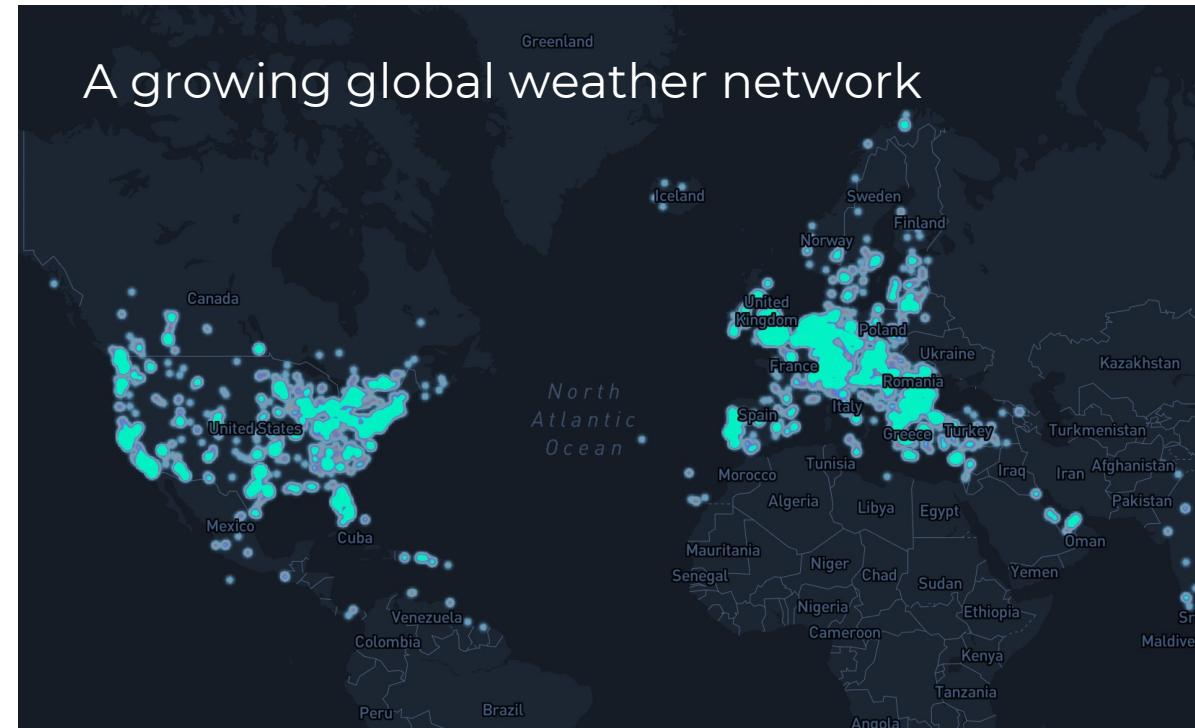


WeatherXM is a community powered weather network, that rewards weather station owners and provides accurate weather services to individuals, businesses and research organizations.

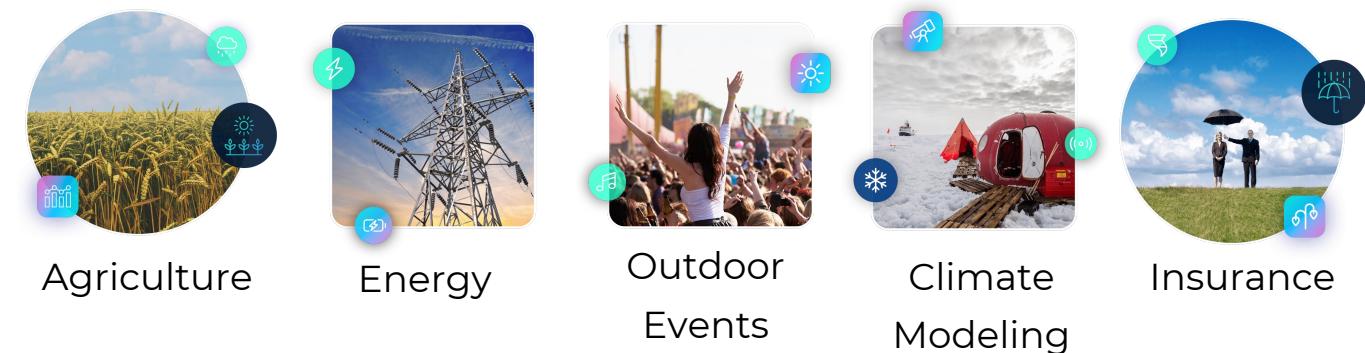


## Parameters

temperature, humidity, precipitation, wind speed, wind direction, barometric pressure, light, UV index, and more!



## Applications



# Compute - Decentralized Cloud Computing

seeed Studio



The Flux Cloud is powered by thousands of FluxNodes connected from all around the globe, and the community is the backbone. By contributing their computational resources, individuals are incentivized accordingly.



Credits & learn more: <https://runonflux.io>

## A Global Cloud Network

Flux Cloud is connected worldwide, across all continents. Its strongest Availability Zones are the EU and United States. South Asia and Australia are also witnessing an increase of server deployments. Flux Cloud is the most decentralized and fastest growing network in the world.

[View Dashboard](#)



## Applications running on Flux Web3



Nexa Node



Radiant Node



Timpi



Fuse Node



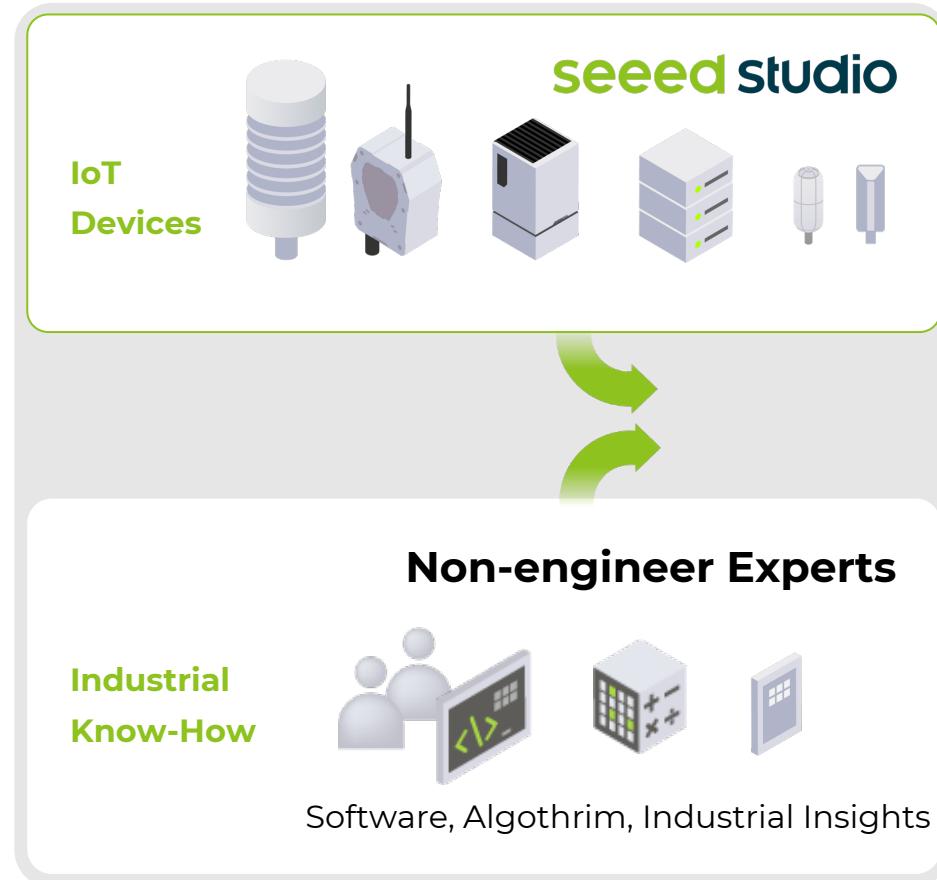
Wanchain Node



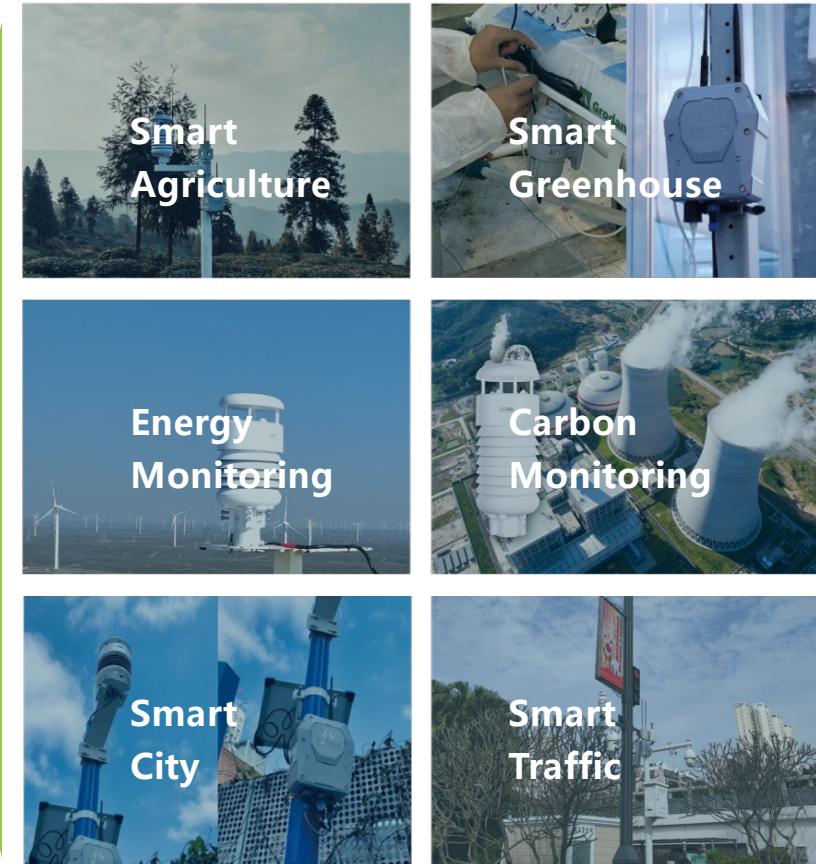
Pivx Node

# Embodied AI as a bridge between science and application

## Co-Invent Solutions



Based on various digital transformation scenarios, we continue to develop smart devices that integrate the latest technologies, and work closely with developers and industry experts to provide software and hardware solutions for vertical industries at multiple levels.





# Let's talk!

violet@seeed.cc



LinkedIn  
@Seeed Studio



Twitter  
@seeedstudio



Discord  
discord.seeed.cc



YouTube  
@Seeed Studio



Project Hub  
[hackster.io/seeed](https://hackster.io/seeed)