

Making sense of the wild

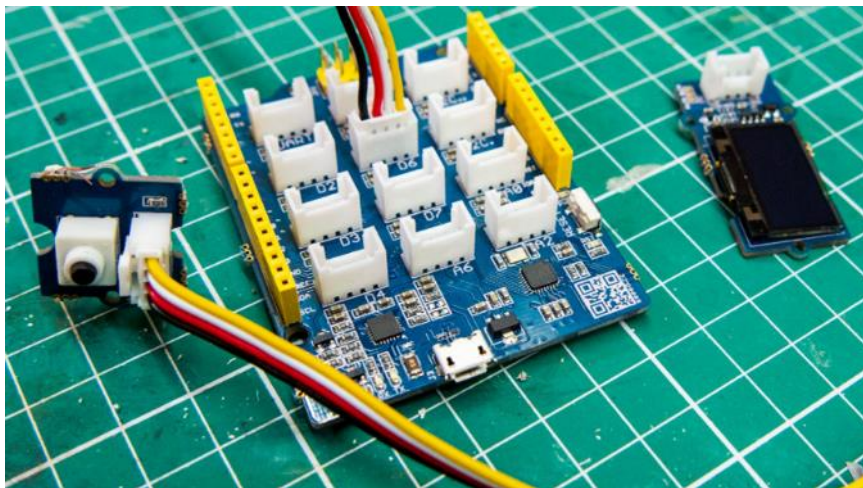
Eric Pan

CEO

seeed studio

seeed studio

seeed studio



How it started since 2008

From possibilities to productivities



How it's going 2022

Community driven, Industry oriented

Global Developer
Communities

Collaborative
Innovation



Digital
Economy

Chips Algorithms Accessories



Integration

Edge Computing

Computing Modules
Edge Computing Devices

IoT Network

Communication Modules
IoT Communication Devices

Smart Sensor

Sensor Modules
Smart Sensor Devices

Solution



Traditional Industries

Services

Instruments
Prototypes

Engineering Kits
Tools and Accessories

seed studio Open technology for the rest of us.

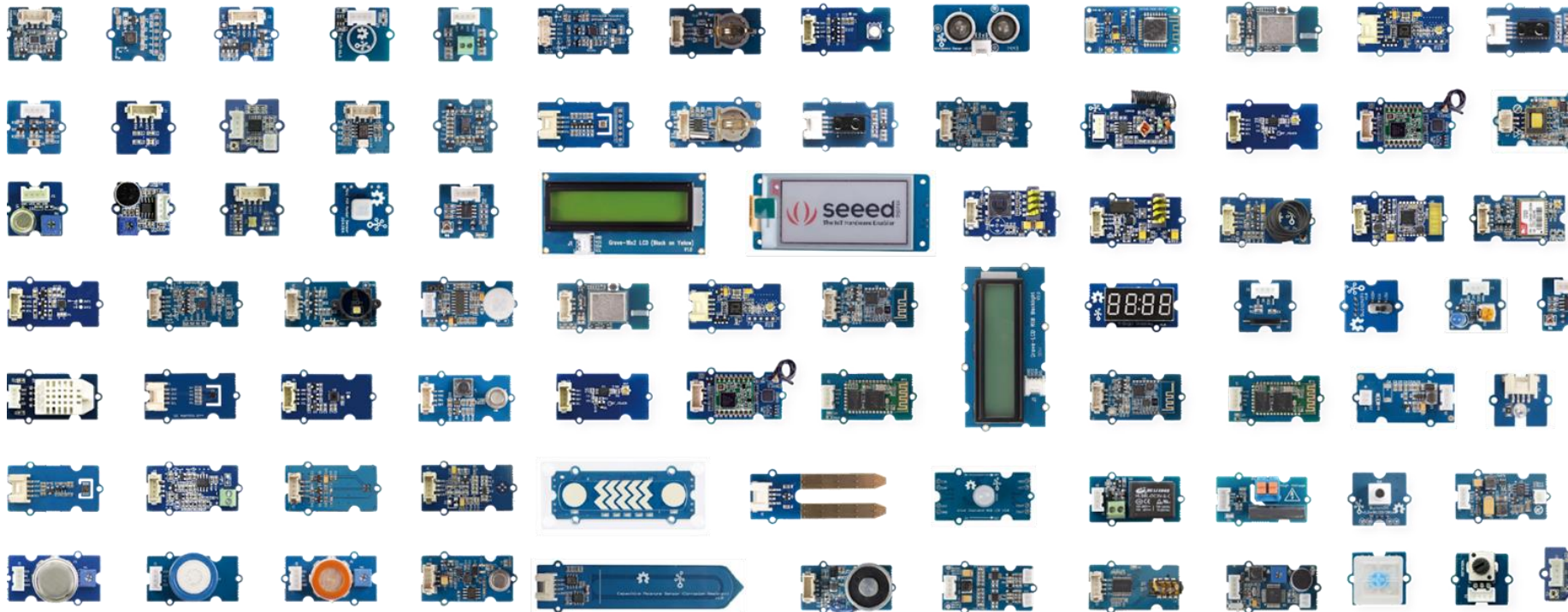
Software Scientific Research Achievements New Materials

Emerging
Technologies

- Digital Infrastructure
- Smart Agriculture
- Smart Environment
- Smart Energy

Making Sense

Open Hardware Sensor system

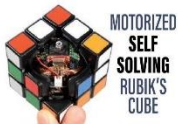


Sensor + TinyML

Multi Gas Sensor + Embedded AI = Smart Nose



Make:



MACHINE LEARNING

Swear Bear... Trash Sorter... Easy AI Trainers
Teach your project to think for itself

BENJAMIN CABÉ'S "NOSE" KNOWS!
Build this smell-identifying AI sniffer

23 PROJECTS!

- Raspberry Pi Meteor Camera
- Digital String Art Portraits
- Animated LED Skirt
- Arduino Borealis Lights

SKILL BUILDERS

- Digital Mobile Radio
- Hack a Knitting Machine

makezine.com | makercampus.com | makerfaire.com

VOLUME 77



Hardware Assembly



Data Acquisition



Model Training



Deploy & Inference



Alcohol classification using the Artificial Nose

Smart Nose for Real Problems

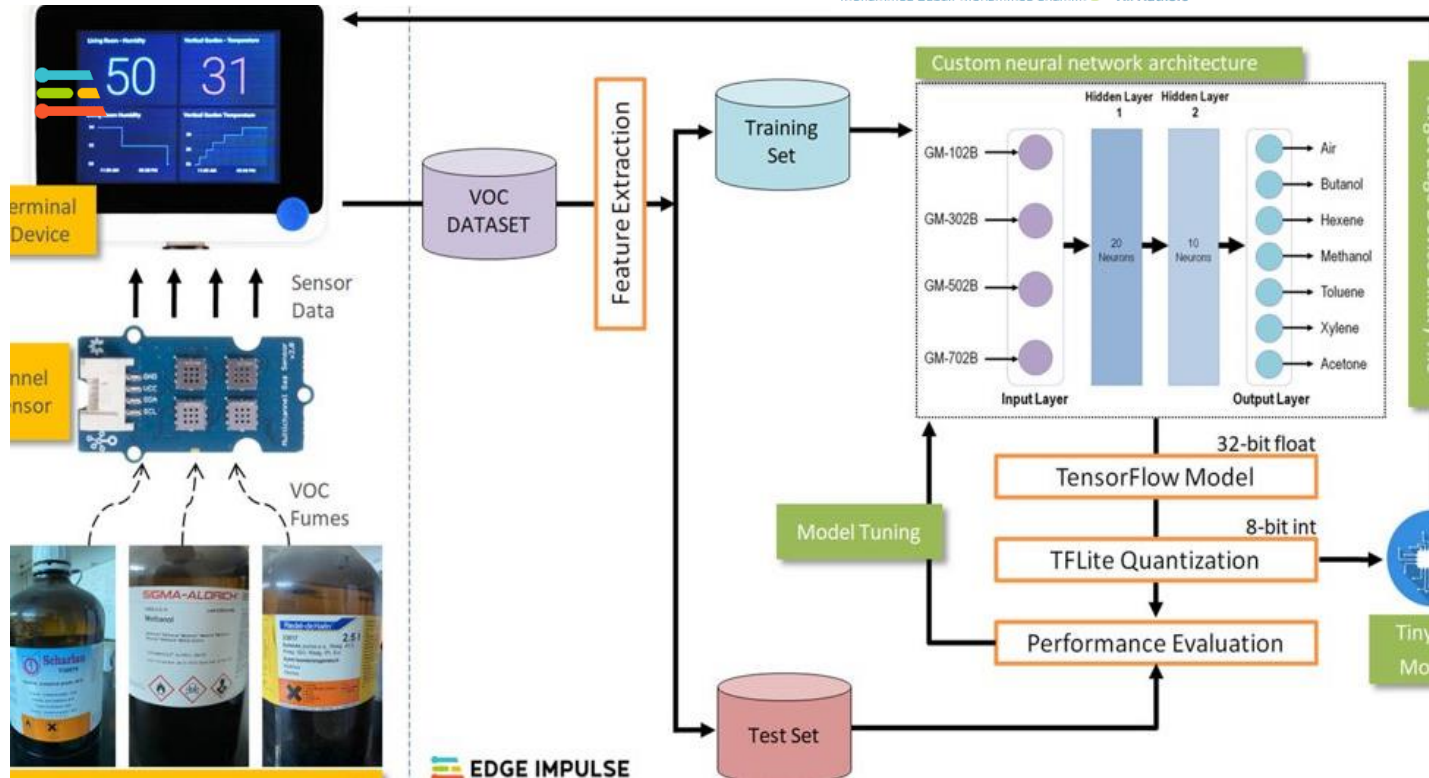
TinyML Model for Classifying Hazardous Volatile Organic Compounds Using Low-Power Embedded Edge Sensors: Perfecting Factory 5.0 Using Edge AI

Publisher: IEEE

[Cite This](#)

[PDF](#)

Mohammed Zubair Mohammed Shamim All Authors



Liquid Classification with TinyML



TDS(Total Dissolved Solids) sensor + Turbidity Sensor + Wio Terminal + Embedded AI = Smart Tongue



TinyML Case Studies

- Seeed Studio Wio Terminal
- Seeed Studio Grove-Vision AI Module
- Seeed Studio XIAO ESP32S3
- Seeed Studio XIAO ESP32S3 Sense
- Seeed Studio XIAO nRF52840 Sense
- Seeed Studio SenseCAP A1101 - LoRaWAN® Vision AI Sensor
- Seeed Studio SenseCAP K1100 – The Sensor Prototype Kit with LoRa® and AI

seed studio

More TinyML
Case study:



The true frontier of IoT

%1 of planetary surface
Civilized
Center of digital world
Crowded

[Cloud]
Established
Omnipotent

[Prototype]
Grove system
TinyML ready

Air Temp&Humidity: 24.80 °C
Air Humidity: 34.38 %RH
Light Intensity: 3230.0 Lux
Barometric : 101390.0 Pa
Wind Speed: 1.1 m/s
Wind Direction: 30° (N)
Rain: 0.6 mm/hour
PM2.5: 12.0 µg/m3
PM10: 17.0 µg/m3

[Edge]
On premise
Interdependent

[Coverage]
Easy deployment
Long range
Ultra low power

[Air]
Temperature
Humidity
CO2e
weather

[Objects]
Vision
Sound
Vibration

[Soil]
Lightness
Temperature
EC

%99 of planetary surface
The wild
Off grid
Far away
Reckless

Air Temp&Humidity: 4.80 °C
Air Humidity: 14.38 %RH
Light Intensity: 5230.0 Lux
Barometric : 61390.0 Pa
Wind Speed: 12.5 m/s
Wind Direction: 20° (N)
Rain: 1.6 mm/hour
PM2.5: 3.0 µg/m3
PM10: 5.0 µg/m3

404 connected

Tigers spotted

draught

caution wildfire

stopped

Bears spotted

53 connected

32 °C 52%

25 °C 42%

31 °C 51%

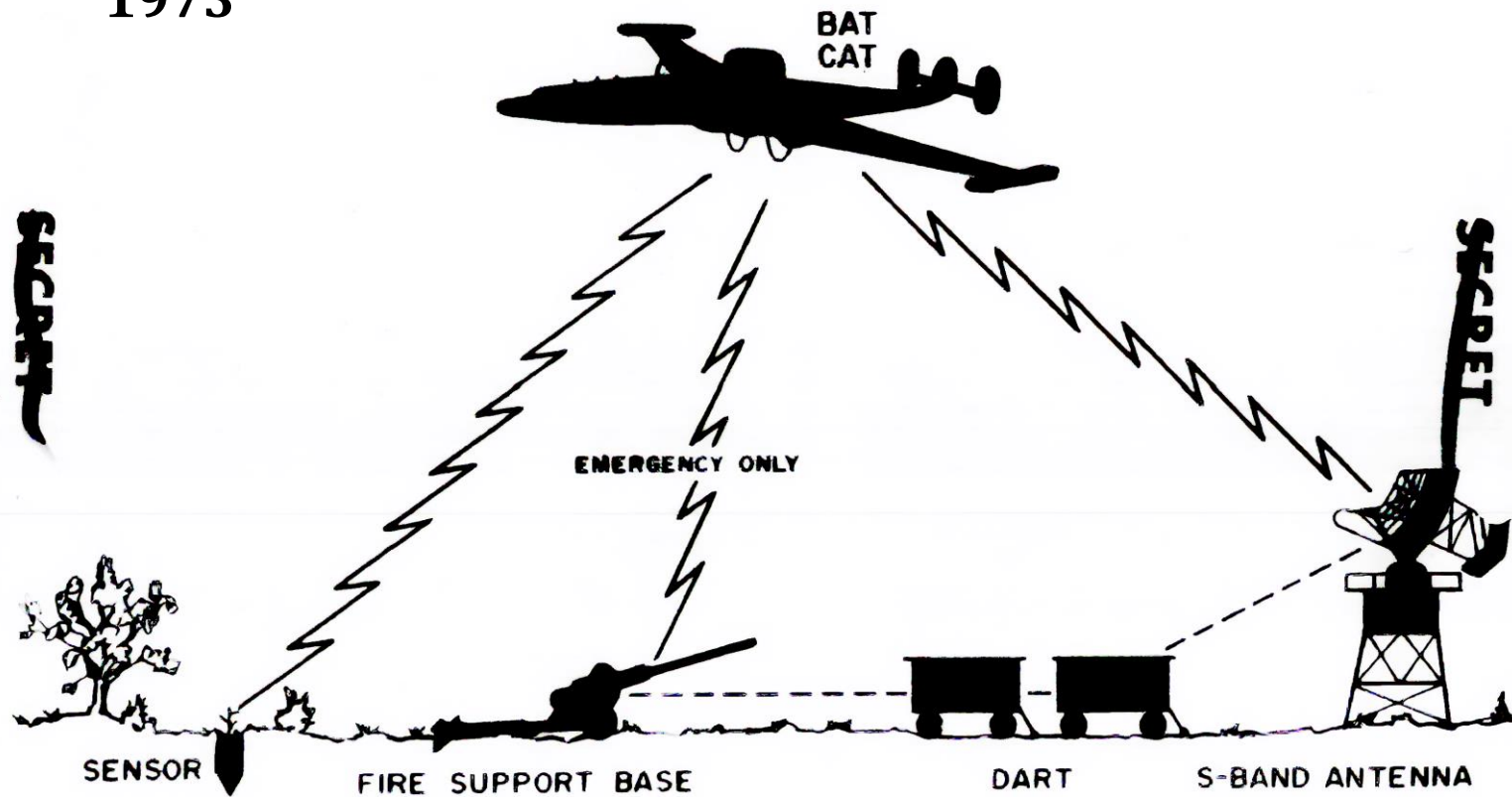
32 °C 51%

Calm and eating

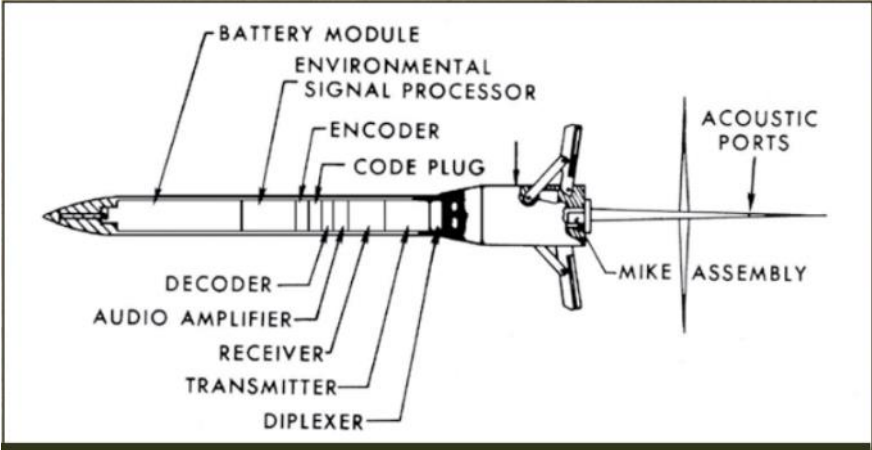
Making Sense Of the Wild

Operation Igloo White

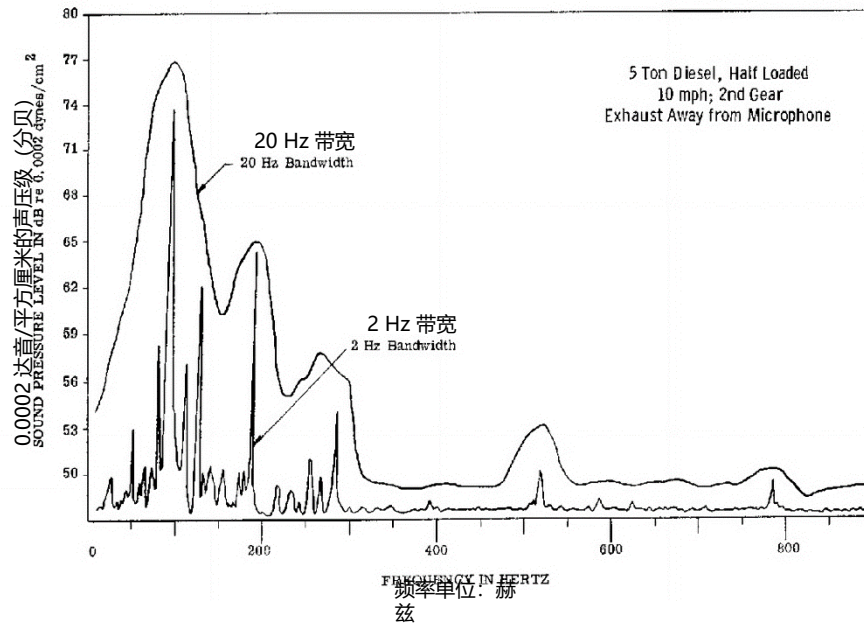
1973



Acoustic Seismic Intrusion Detector



'T-1151' Dog Doo Transmitter



A huge failed IoT piloting project:

Investment:

1 billion dollars annually

- **\$30 million** orbit reconnaissance aircraft for signal transmission.
- **\$20 million** command post
- Deploying four **\$10 million** worth of fighter jets
- **\$40 million** worth of sensors
- Huge system and personnel maintenance costs

Results:

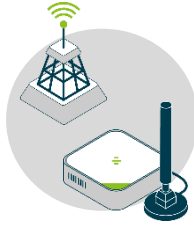
5000\$ and

- Elimination of **\$5000** worth of trucks and several combat units
- Significant collateral damage to civilians

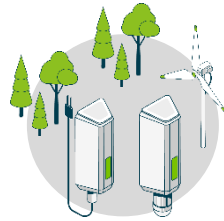
50 years later...

What's different today?

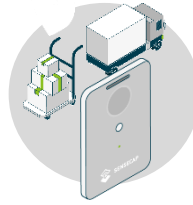
- Millions of Long range communication infrastructure
- Millions of Cheap sensor with embedded AI
- Millions of makers all over the world



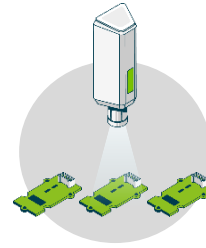
LoRaWAN®
Network



Multi modal Sensing



Location based
sensing



Edge Inference



Distributed
Cloud



Low power long range networks



Water



Cameras



Air



Location



Temperature & Humidity



Meteorology



Alarm



Others

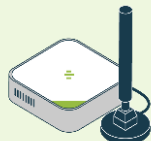
Thing centric infra

Coverage > 10KM

People centric infra

Coverage < 1KM

LoRaWAN



Gateway



4G/5G



WiFi

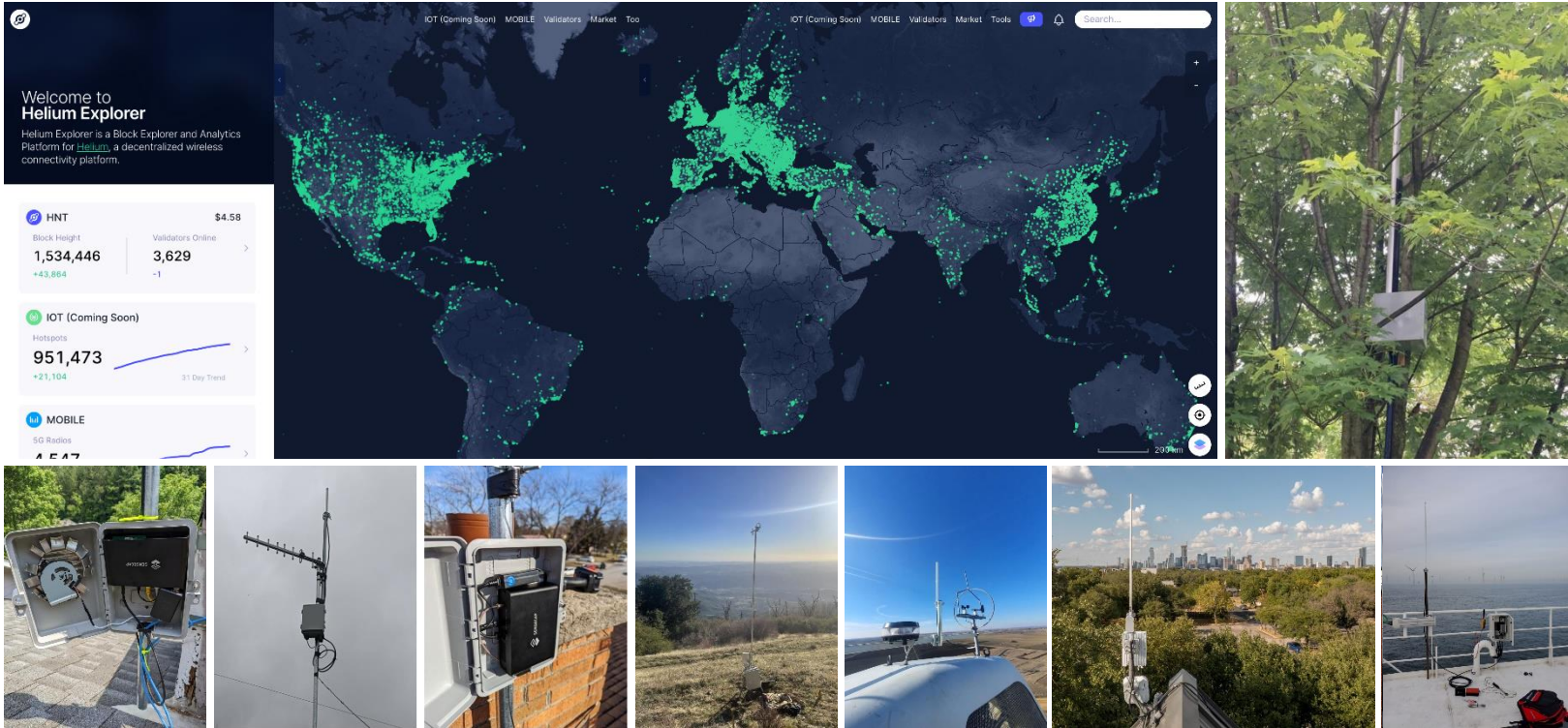


Ethernet



...ets ready for long range IoT

LoRaWAN Network rapid growing (Helium & TTN)



pervasive LoRaWAN infrastructure

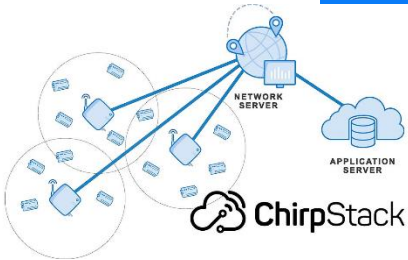


hijack consumers > 10,000,000 hotspots

web3 infra >1,000,000 hotspots

by operators

private



THE THINGS NETWORK



HELIUM



SenseCAP S210x Sensors

SenseCAP S210x series' sensors offer long-distance data acquisition via LoRaWAN®. With IP66 enclosure rating, the sensors can operate in extremely low and high temperature zones (-40°C to +85°C). Their built-in, 19AH high capacity battery, S210x series can operate in harsh, outdoor environments up to 10 years with a range of up to 10km. To add, the built-in Bluetooth made them easy to be configured and deployed, that together reduces field deployment costs. Moreover, users can get data in just a few steps, and with open Cloud API, they are easy to be integrated.

10 years, 10KM, 10\$(not yet)



SenseCAP S2100 LoRaWAN® DTU

NEW

LoRaWAN Data Logger

SKU [114992872](#)

Overview

SenseCAP S2100 Data Logger can connect to Modbus-RTU RS485/Analog Input/GPIO sensors and transmit data from sensors to the LoRaWAN® network. It is specifically optimized for OTA with built-in Bluetooth, which enables quick setup and update. It can be battery-powered or connected to a 12V external power supply. With the help of S2110 sensor builder, S2100 Data Logger is able to connect to Seeed Studio's wide range of Grove Sensors, which will make it the ideal solution for developing, fast prototyping, and small deployment for DIY Industrial level LoRaWAN® Sensors.

Physical World



Agriculture



Industrial Control

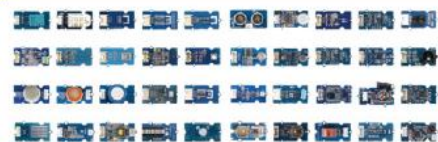


Energy

Expanding to 400+ Grove Sensors



S2110 Sensor Builder



Increased to 100+ Industrial Sensor Probes



Water

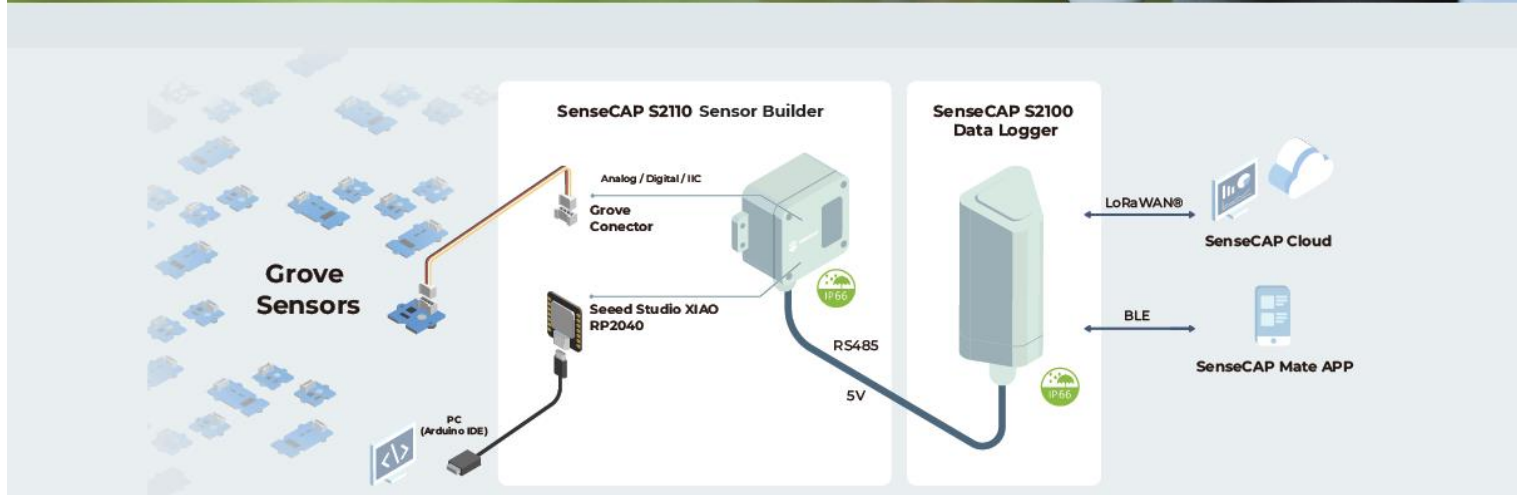


Air



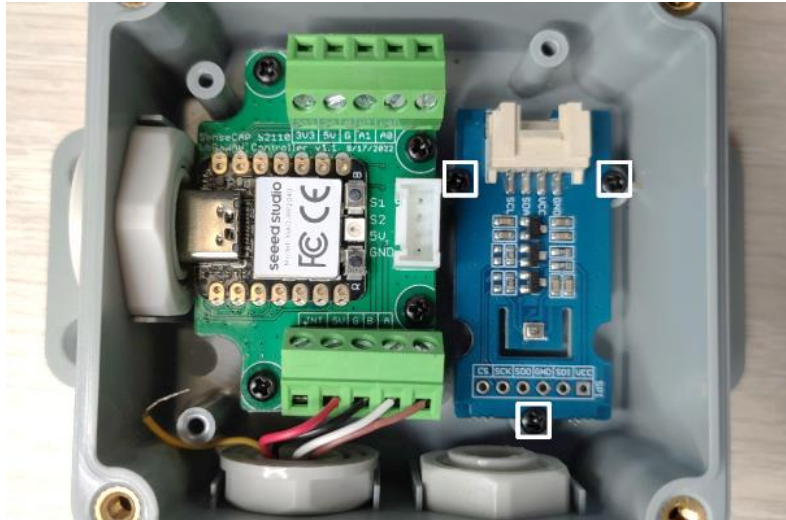
More...





Build your own sensors

Or use light sensor by default

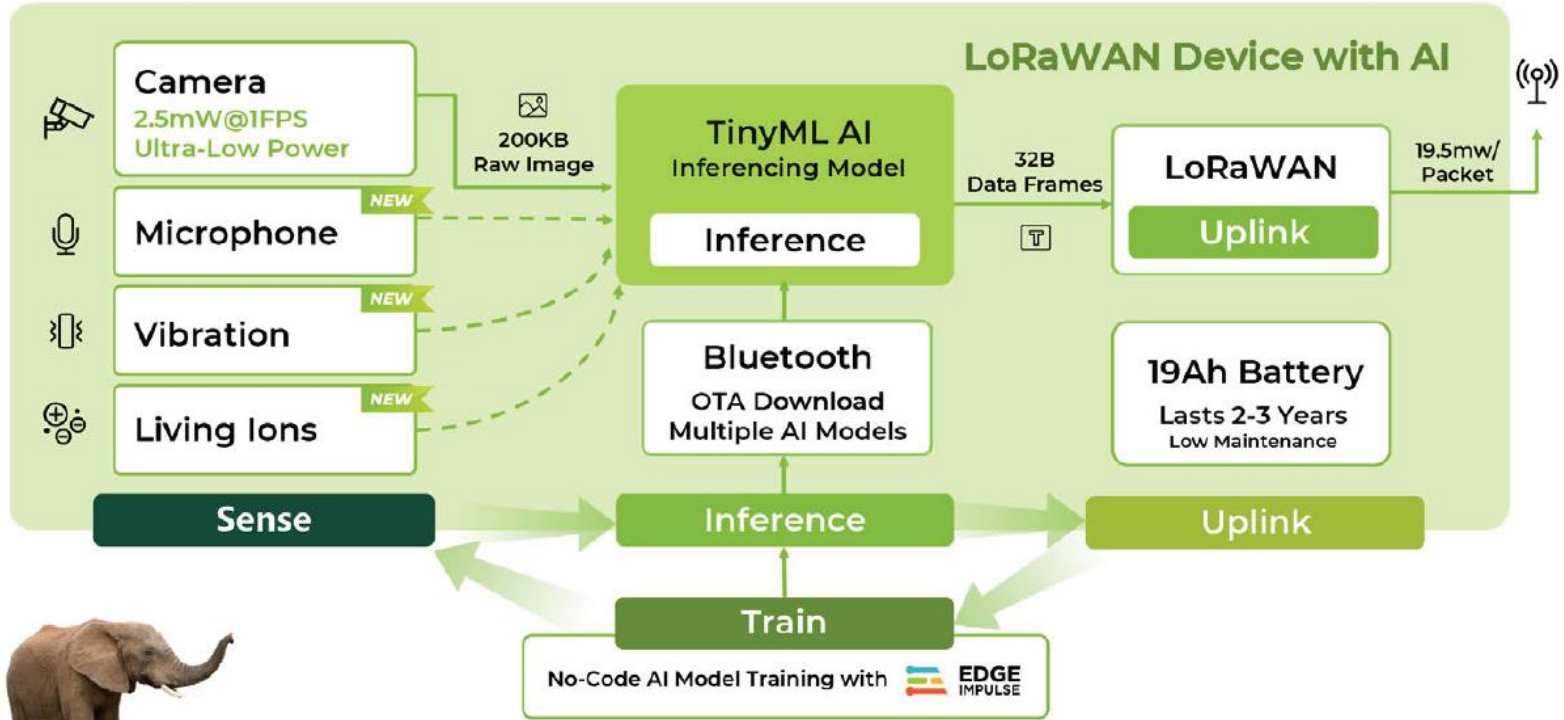


https://github.com/Seeed-Studio/Seeed_Arduino_S2110

Modbus Register Table

| Grove Sensor Name | Register Name | Register Address (Hexadecimal) | Register Address (Decimal) |
|--|------------------------|--------------------------------|----------------------------|
| Grove - CO2 & Temperature & Humidity Sensor (SCD41) | Temperature | 0x0004 | 04 |
| | Humidity | 0x0006 | 06 |
| | CO2 | 0x0008 | 08 |
| Grove - Light Sensor v1.2 | Light | 0x000A | 10 |
| Grove - Flame Sensor | Flame | 0x000C | 12 |
| Grove - Oxygen Sensor (MIX8410) | Oxygen | 0x000E | 14 |
| Grove - Sunlight sensor (SI1151) | Light Intensity | 0x0010 | 16 |
| | Visible Light | 0x0012 | 18 |
| | UV | 0x0014 | 20 |
| Grove Temperature and Barometer Sensor (BMP280) | Barometric Temperature | 0x0016 | 22 |
| | Atmospheric Pressure | 0x0018 | 24 |
| | Height | 0x001A | 26 |
| Grove - Temperature Humidity Pressure Gas Sensor(BME680) | Temperature | 0x001C | 28 |
| | Atmospheric Pressure | 0x001E | 30 |
| | Humidity | 0x0020 | 32 |
| | Air Quality(VOC) | 0x0022 | 34 |
| Grove - Gas Sensor V2(Multichannel) | NO2 | 0x0024 | 36 |
| | C2H5OH | 0x0026 | 38 |
| | VOC | 0x0028 | 40 |
| | CO | 0x002A | 42 |
| Grove - UV Sensor | UV Intensity | 0x002C | 44 |
| Grove - Turbidity Sensor Meter V1.0 | Turbidity | 0x002E | 46 |
| Grove - TDS Sensor | TDS | 0x0030 | 48 |
| Grove - Ultrasonic Ranger | Distance | 0x0032 | 50 |

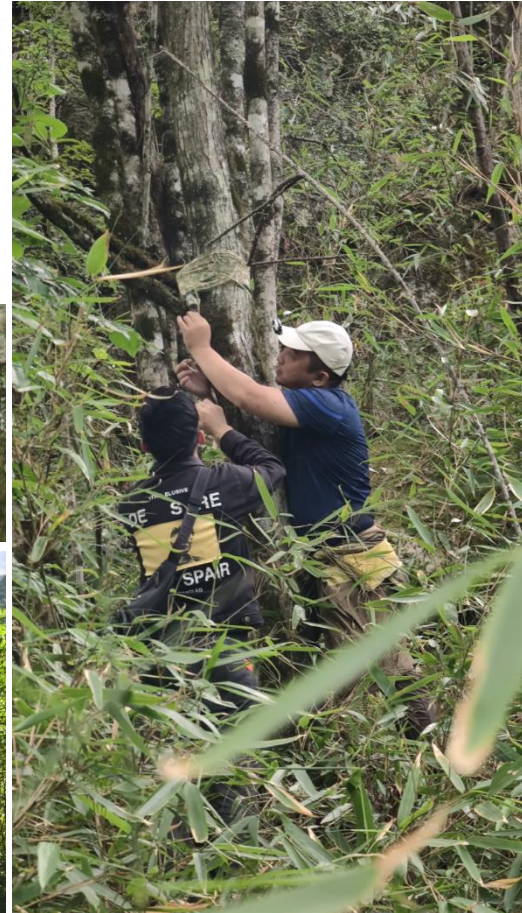
Perfect combination between TinyML and LoRaWAN



Panda Sensor: Detection and Tracking in Sichuan, China

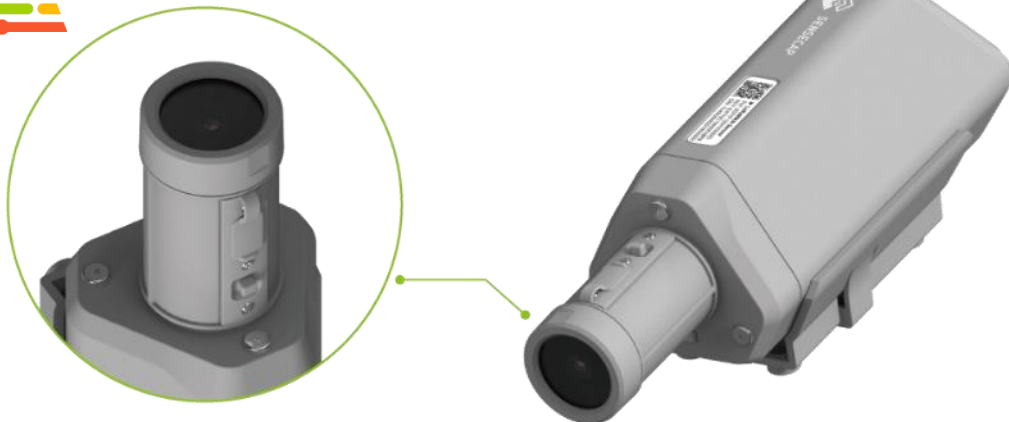
It is a vision-based tracking system deployed in "Laohegou Nature Reserve", so as to monitor wild pandas in Sichuan Province, China. Through combining Computer Vision AI and LoRaWAN technology, the system alerts when it detects and tracks pandas in the wild to help the conservation of the beloved creatures.

Wild panda monitoring has been traditionally done manually by rangers, which was difficult, time-consuming, and inefficient. Through this digitalized system, the rangers can monitor illegal activities (such as poaching and invasion), that can help protect animals from various risks in wildlife habitats. The application of real-time monitoring and intelligent identification technology can not only reduce human interference to the conservation areas, but also shorten the distance between pandas and the outside world.

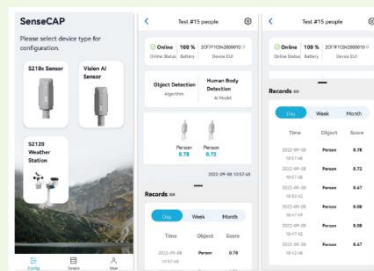
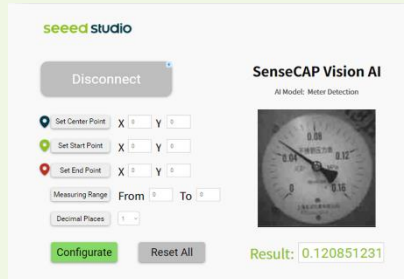
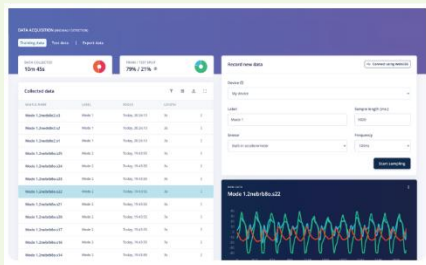


SenseCAP A1101

LoRaWAN Vision AI Sensor



- Ultra-low power AI chipsets
- Built-in AI inference
- Long Range transmission
- Up to 10 years battery life
- IP66 protection
- Designed for wild deployments



79\$ MSRP

Train at Edge Impulse

Deploy and verify

Remote sensing with APP

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All in one TinyML sensor



Xiao
= 小 (xiǎo)
= Tiny

Seed Studio XIAO ESP32S3 Sense

Ultra-small ESP32-S3 development board with OV2640 camera

HIGH-PERFORMANCE

240MHz Xtensa 32-bit LX7 dual-core processor

MEMORY

8MB PSRAM + 8MB FLASH

MULTI-FUNCTIONAL

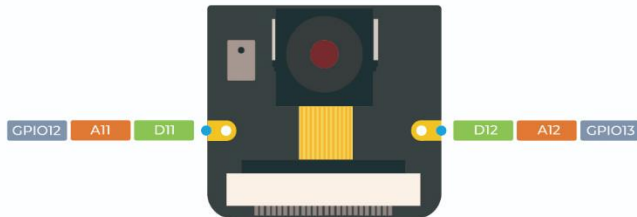
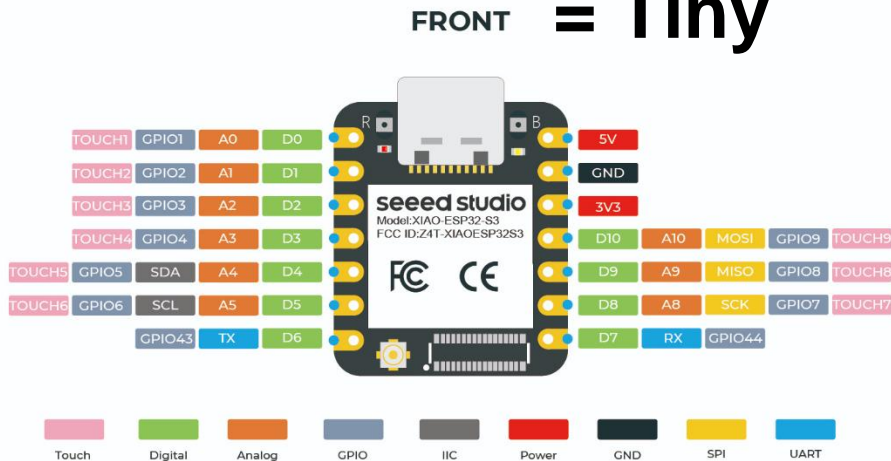
Microphone/SD card slot/Detachable OV2640

WIRELESS

2.4GHz WiFi and BLE 5

TINYML-SUPPORTED

Image Processing/Speech Recognition

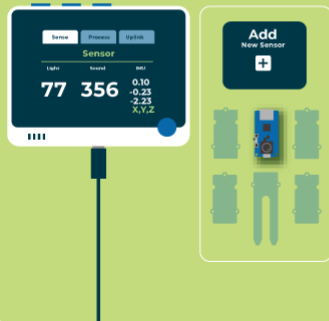


SenseCraft: No Code & No IoT



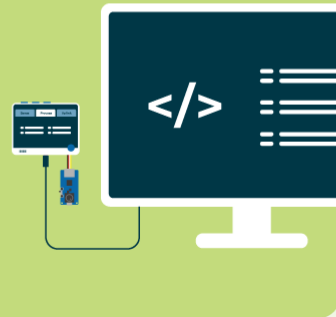
1 Sense

Built in & Add on



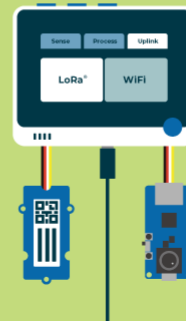
2 Process

Data Handling & Machine Learning



3 Uplink

Network Connectivity



* The LoRa® Mark is a trademark of Semtech Corporation or its subsidiaries.

-Tech4All: no node needed to overcome barrier to build AIoT projects;

-Open & Inclusive: supports various open source hardware platforms



Open Source on GitHub: <https://github.com/Seeed-Studio/SenseCraft>

| Perception system for real world data



Smart Sensors
- Collect data -



Long range network
- Coordinate data -



Edge computing
- Process and store data -

**Making Sense
Of the Wild
With the community**

IoT2wild Contest

Website: <https://www.hackster.io/contests/iotinthewild>

Winner announced at Hackster Impact Summit on October 11, 2022

seed studio | hackster.io | Impact Summit

**Winner Announcement:
IoT Into the Wild Contest for Sustainable Planet 2022**

October 11th, 2022
14:15P.M.-14:30P.M.
Pacific Standard Time

REGISTER NOW

Early Detection of Harmful Algae Bloom

A woman in a green shirt is kneeling on a boat, holding a small electronic device. In the background, there are water level gauges showing various readings.

Early flash flood warn system

A red frame is set up on a rocky bank next to a river. A yellow warning sign is visible. Text overlays show "flood 0.75" and "flood 0.62".

GATE KEEPER
An IoT BASED ELEPHANT DETECTION SYSTEM

A group of people are gathered around a red balloon. One person is holding a small orange object attached to the balloon.

A group of elephants is shown in a natural setting. Below the image are social media icons for GitHub, LinkedIn, Facebook, and others.

Wild Animal Tracker

A person is holding a smartphone displaying a tracking application. The background shows a forest with a deer.

MonChan
Mountain Chain

Danger notification to save people!

A man is holding a smartphone displaying a notification. A red device is attached to a mountain chain.

A bird feeder is shown in a cage-like structure. A person is holding a smartphone displaying a notification.

A yellow IoT device is shown on a table. A person is holding a smartphone displaying a notification.

TO CHECK PLASTIC BOTTLE SUPPLIED TO THE LAKE

A person is holding a smartphone displaying a notification. A red device is attached to a plastic bottle.

Biolight
Harmful Algal Bloom Prediction and Monitoring

A person is holding a smartphone displaying a notification. A red device is attached to a water sample.

NOMOS
Say NO to Mosquitoes

Mosquito Growth Monitoring System in Urban Areas to Minimize the Impact of Mosquitoes by Any Means

A person is holding a smartphone displaying a notification. A red device is attached to a mosquito.

Emergency Notification System for Wildfires in California

A person is holding a smartphone displaying a notification. A red device is attached to a wildfire.

Monitoring Illegal Sand Mining

A person is holding a smartphone displaying a notification. A red device is attached to a sand mining site.

A person is holding a smartphone displaying a notification. A red device is attached to a sand mining site.

LORA ANTENNA

A person is holding a smartphone displaying a notification. A red device is attached to a LORA antenna.

FIGHT FIRE
PREDICT WILD FIRE, RESPOND QUICKLY & SAVE NATURE

ENTER: SOIL TEMPERATURE, HUMIDITY, GROVE LOCA, GROVE DATA - TEMP AND HUMIDITY, MOIST SOLAR CHARGER, SPACE-LI-ION CHARGER, WIND TERMINAL, SMOKE SENSORS, PRESSURE AND ENVIRONMENT

POWERED BY: EDGE IMPULSE, seed, helium, MakerGreen

A person is holding a smartphone displaying a notification. A red device is attached to a fire.

Livestock / Wildlife Counting from Drone with FOMO algorithm

A person is holding a smartphone displaying a notification. A red device is attached to a drone.

Black Soldier Fly Farming

A person is holding a smartphone displaying a notification. A red device is attached to a Black Soldier Fly farm.

A person is holding a smartphone displaying a notification. A red device is attached to a field.

Smart Lake - Early Detection of Algae Bloom

By, Sashrika Das & Mithun Das

Keywords: Climate Crisis Prevention/Mitigation, LoRaWAN, Blockchain, AWS

Project Description

Using data from different sensors and ML on the edge, this device can detect early sign of algae bloom and notify authorities or citizens.

Highlights

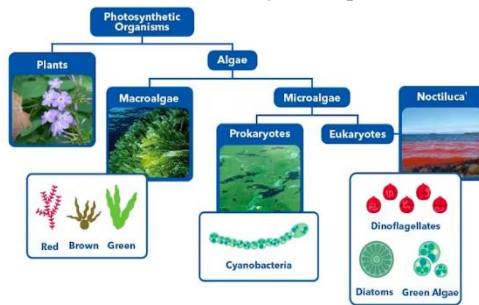
- Multi-model sensing
- Edge AI for inference
- Long-range, low-power monitoring
- Full stack open source



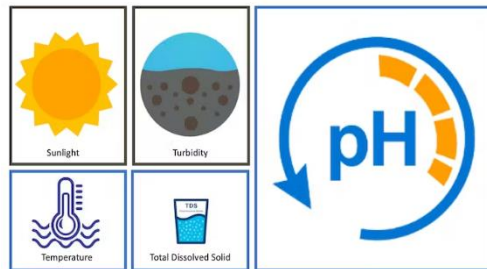
Scan to Know More

Make Sense of the Wild

Sustainability Topic



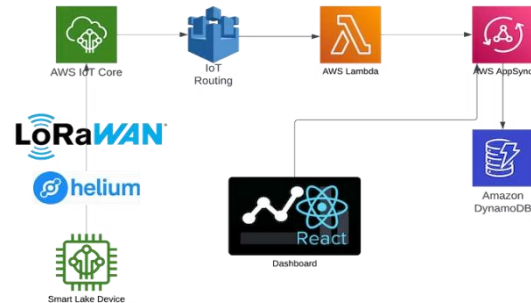
Key Info to Monitor



Prototype



System Diagram



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AgroLoRa

By, EdOliver & Victor Altamirano

Keywords: Precision Farming, LoRaWAN, Helium, AWS

Project Description

Automated irrigation and crop health monitoring device for local and urban farming, developed on the basis of SenseCAP K1100 Kit, while performing predictive agriculture analytics via Helium network.

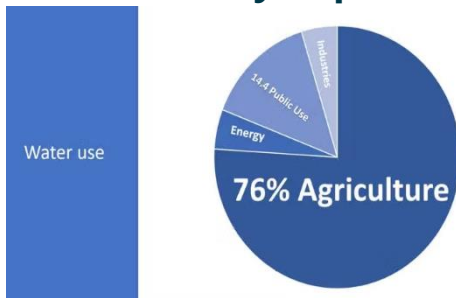
Highlights

- All-in-one, inexpensive precision farming solution
- Predictive analysis
- Long-range, low-power monitoring
- Full stack open source



Scan to Know More

Sustainability Topic



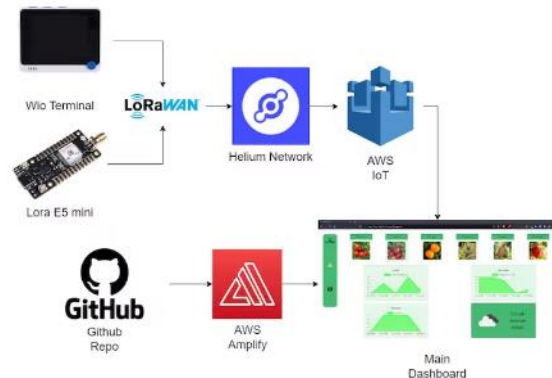
Prototype



Key Info to Monitor



System Diagram



IoT AI-Driven Tree Disease Identifier w/ Edge Impulse & MMS

By, Kutluhan Aktar

Keywords: Tree Disease, Edge Impulse, MMS

Project Description

Tree disease identifier using SenseCAP K1100 Kit, Wio Terminal, and Grove sensors (CO₂, temperature, humidity sensors) to collect data from trees infected with different types of plant diseases, and then uses Edge Impulse to train the object detection model with machine learning, and finally, receives the detection results and early warning notifications through MMS.

Highlights

- Web application in PHP to save the transferred detection results (images)
- Long-range, low-power monitoring
- Full stack open source



[Scan to Know More](#)

Sustainability Topic



Prototype



Key Info to Monitor



System Diagram



Weather Balloon "Mining" Using Blockchain and IoT

By, Nicolas Lopez

Keywords: Climate Crisis Prevention, LoRaWAN, TTN, Node-RED

Project Description

Floating balloon to measure meteorological data 32,000 feet above West Africa, using a Grove sensor (air temperature, humidity, barometer sensor). Helium's LoRaWAN network was used to transfer the collected environmental data, after which Node-RED (no-coding platform) was used to process weather observations and authentication checks.

Highlights

- 25 launches of weather balloons with students in Africa and the USA
- Long-range, low-power monitoring
- Full stack open source



Scan to Know More

Sustainability Topic

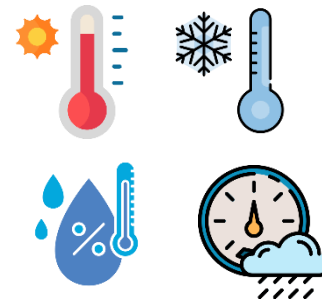
NATURAL DISASTERS



Prototype



Key Info to Monitor



System Diagram



Study of Animal Movement: Equipment Design and Development

By, Laila Kazimierski et al.

Keywords: Wildlife Conservation, Biodiversity, LoRaWAN, Arduino IDE

Project Description

Wildlife movement and behavior tracking device for endangered species to research about their biology, using Wio Terminal, Grove - Long Range 868MHz, and Arduino IDE. Used for field monitoring in mapping out and monitoring the animal's movement patterns, trajectories, nests, and natural environmental habitats in real-time.

Highlights

- Latest status quo of the wildlife and their natural habitats
- Long-range, low-power monitoring
- Full stack open source



[Scan to Know More](#)

Sustainability Topic



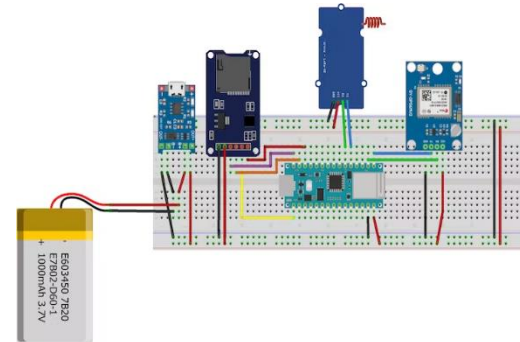
Prototype



Key Info to Monitor



Hardware Diagram



MonSand: Monitoring Illegal Sand Mining

By, Raunak Singh

Keywords: Illegal Sand Mining, Marine Conservation, LoRaWAN, Helium

Project Description

A device that detects illegal sand mining activities in the oceans and river banks, by using Wio Terminal, SenseCAP K1100 Kit, Grove Lora E5, after which the collected data is sent to Helium Console, and then the monitoring outcome analysis will be directly shown on Google Sheets to send SNS to relevant authorities, either government agencies or NGOs.

Highlights

- Embedded system to map out illegal sand mining sites
- Long-range, low-power monitoring
- Full stack open source



Scan to Know More

Sustainability Topic



Prototype



Key Info to Monitor



System Diagram



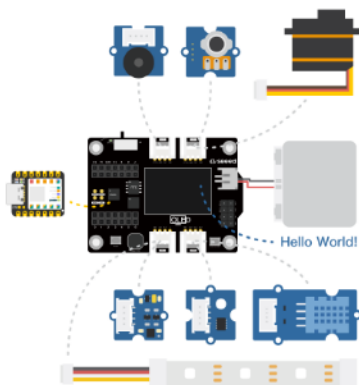
XIAO Empowers TinyML in Academy

Ready-To-Use XIAO Course: Big Power, Small Board - Mastering Arduino and TinyML



This course uses a project-based approach and hands-on practice to teach students how to create projects with Seeed Studio XIAO, from simple LED lighting to TinyML projects. Community-made project cases are also included to inspire students to explore the technological possibilities of XIAO.

| | Low-End MCU | High-End MCU | NPU (Neural Network Processor) | MPU (Microprocessor) | GPU (Graphics Processor) |
|---------|------------------------------|----------------------|--------------------------------|-------------------------|--------------------------|
| | Sensor Fusion Classification | Audio Classification | Image Classification | Complex Images or Sound | Video Classification |
| Memory | 18KB | 50KB | 256KB | 1MB+ | 1GB+ |
| Sensors | ✓ | ✓ | ✓ | ✓ | ✓ |
| Audio | ✓ | ✓ | ✓ | ✓ | ✓ |
| Images | | ✓ | ✓ | ✓ | ✓ |
| Videos | | ✓ | | ✓ | ✓ |



Rich TinyML Projects from Community as Open Source TinyML Teaching Materials ...

Community Project

1. Exploring Machine Learning with the New XIAO ESP32S3

Marcelo Rovai showcased his latest project, delving further into the world of machine learning, by introducing the newest member of the XIAO family: the XIAO ESP32S3. In this project, he added a low-cost MCU and harnessed the power of edge impulse to detect anomalies and classify motion.

Seeed Studio XIAO ESP32S3 leverages 320MHz Xtensa 32-bit LX7 dual-core processor, supporting both WiFi and BLE 5.0 wireless connectivities, allows for deep sleep mode with power consumption as low as 14uA, while supporting lithium battery charging management. Ideal for the Internet of Things, Smart Homes, Wireless wearable devices, Robotics, etc.

Seeed's hardware used in this project:

Seeed Studio XIAO ESP32S3

Softwares used in this project:



[Read the full project on Hackster](#)

XIAO ESP32S3



Community Project

Community Project

2. TinyML Made Easy: Image Classification

Marcelo Rovai shared a comprehensive tutorial covering an introduction to Seeed Studio XIAO ESP32S3 Sense and an image classification project where Marcelo demonstrates how to collect fruits versus veggies datasets, from Kaggle and train a model using Edge Impulse. The trained model is then deployed as an Arduino library in a zip format and uploaded to the XIAO ESP32S3 Sense, enabling users to classify fruits and vegetables with ease.

Seeed Studio XIAO ESP32S3 Sense integrates a camera sensor, digital microphone, and SD card support. Combining embedded ML, computing power and photography capability, this development board can be your great tool to get started with intelligent voice and vision AI.

Seeed's hardware used in this project:

Seeed Studio XIAO ESP32S3

Softwares used in this project:



[Read the full project on Hackster](#)

XIAO ESP32S3



Community Project

XIAO in TinyML4D

tinyML Talks

Enabling Ultra-low Power Machine Learning at the Edge

"Unleashing the Power of the New XIAO ESP32S3 Sense:
Tackling Anomaly Detection, Image Classification, and
Keyword Spotting with TinyML"

Marcelo Rovai – Co-Chair, TinyML4D group

June 13, 2023



www.tinyML.org

"The new XIAO ESP32S3 development board is an ideal fit for TinyML education and projects in developing countries due to its affordability, high quality, and ease of setup and use."

--- Quote from Prof. Marcelo Rovai



Student Project: A "Personal Trainer" Built on XIAO nRF52840 Sense using TinyML



Professor Stalin Arcienega from the University of Ecuador (PUCIESE), which streamed the Talk with his engineering students:

TinyML Case Studies



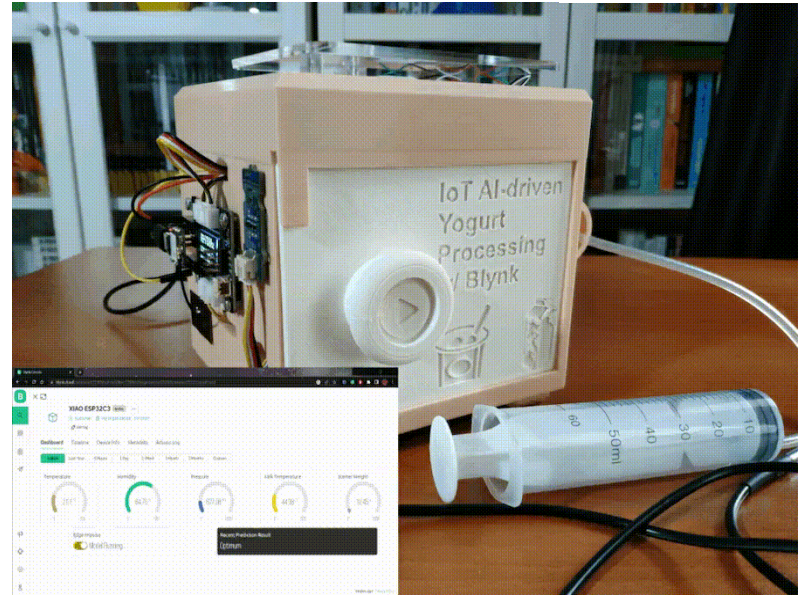
IoT AI-driven Yogurt Processing & Texture Prediction by Kutluhan Aktar

Background

Yogurt's quality is affected by factors like temperature, humidity, pressure, milk temperature, and the presence of yogurt bacteria. Chemical additives are commonly used, but there's a growing demand for additive-free yogurt.

Solution

This project measures key data points using temperature and humidity sensors, as well as pressure sensors, to estimate the consistency level of yogurt. It uses XIAO ESP32C3 to build and train an artificial neural network model, which analyzes the collected data to determine the most suitable environmental conditions for yogurt fermentation.



Softwares used in this project:



A Pet Activity Tracker using XIAO BLE Sense & Edge Impulse

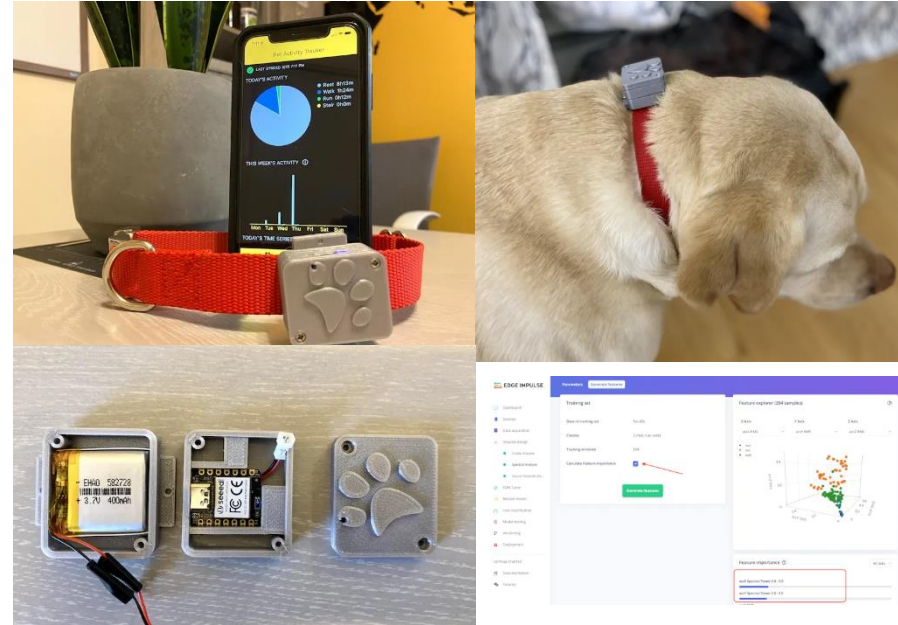


Background

Why should humans have all fitness trackers? Our pets deserve more to stay active. We love our pets and we want the best for our pets: good health, deep sleep, nutritious food—essentially, all the things that ensure a long, happy life together.

Solution: A Low-Cost and Flexible Fitness Tracker Especially for Pets

This tracker only includes an XIAO nRF52840 Sense, a rechargeable battery, and a case on the hardware side. Mithun Das trained a TinyML model to make the pet's activity recognizable and identifiable and designed an accompanying mobile app connected to the device over Bluetooth and a microcontroller sends prediction data every minute. Data is stored on mobile local storage and plotted on graphs to provide meaningful insight.



Next?

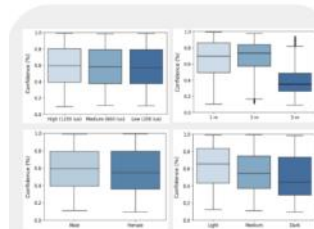
Unify the AI sensor standards and create more



(Section 4.5)



(Section 4.2)



(Section 4.4)

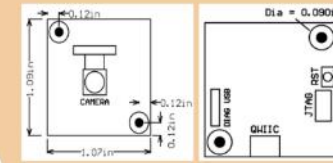


Matthew Stewart^{1*} Pete Warden^{2,5} Yasmine Omri¹ Shvetank Prakash¹ Joao Santos¹
 Shawn Hymel⁴ Benjamin Brown¹ Jim MacArthur¹ Nat Jeffries⁵ Brian Plancher³
 Vijay Janapa Reddi¹

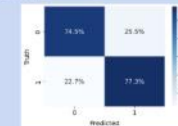
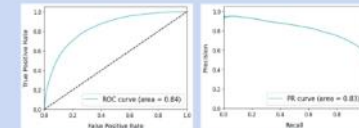
¹Harvard University ²Stanford University ³Barnard College, Columbia University
⁴Edge Impulse ⁵Useful Sensors



(Section 4.8)



(Section 4.6)



(Section 4.3)

Co-Invent Solutions with vertical-specific models

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.

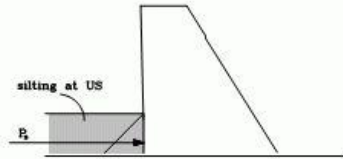


bridge between science and practice

(4) Silt Pressure

$$P_{silt} = \frac{1}{2} * \gamma_{silt} * h_{silt}^2 * k_a$$

neglected, if considered after time a part of the dam



(5) Wave Pressure

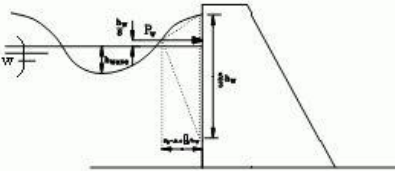
$$P_{wave} = \frac{1}{2} \left(\frac{5}{3} h_w * 2.4 \gamma_w h_w \right)$$

$$= 2000 h_w^2 \text{ kg/m}^2$$

$$= 2 h_w^2 \text{ t/m}^2$$

P_w = wave force

h_w = wave height



$$= 0.032 \sqrt{VF} + 0.763 - 0.271 F^{\frac{1}{4}} \quad (F < 32 \text{ km})$$

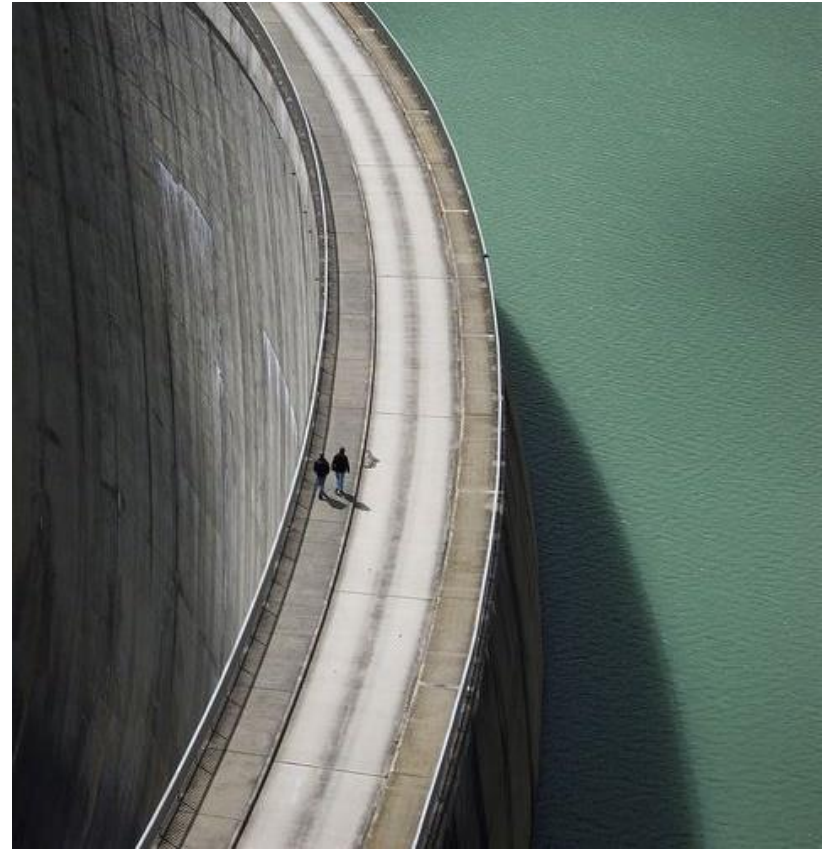
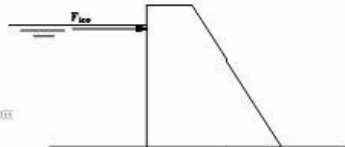
$$= 0.032 \sqrt{VF} \quad (F \geq 32 \text{ km})$$

V = wind speed (km / hr), F = straight length (km)

(6) Ice Pressure

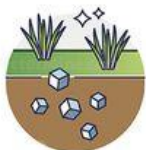
$$F_{ice} = 50 * h_{ice} * \gamma_w \text{ t/m}^2$$

$$\approx 25 - 150 \text{ t/m}^2$$



From data to GPT insights

SUSTAINABLE AGRICULTURE



SOIL SALINITY
MANAGEMENT



POST HARVEST
LOSSES MANAGEMENT



LIVESTOCK
MANAGEMENT



WATER AND IRRIGATION
MANAGEMENT



ENERGY
MANAGEMENT



ERROSION
MANAGEMENT



INTEGRATED PESTS
MANAGEMENT



PASTURELANDS
MANAGEMENT



NUTRIENTS AND SOIL
FERTILITY MANAGEMENT



WETLANDS
MANAGEMENT



FISHERY AND AQUACULTURE
MANAGEMENT

14:52 [Signal] [Wi-Fi] [Battery]

AI answers are provided for reference only. Please use them with caution as SenseCAP cannot be held responsible for any consequences resulting from the use of AI services.

Crop or Animal *

Input the crop or animal

Location *

Input Location

Time *

1 Month 6 Months 1 Year

Measurements(up to 5) * +

Send

Device AIGC Mail User

SenseCAP AI

SenseCAP AI X

these are the data of Soil Temperature, Soil Moisture, Electrical Conductivity for the last Month , Based on these data, please give some suggestions.

Environmental Data analysis:
The average soil temperature of 26.49°C in Sichuan is suitable for strawberry cultivation. However, further analysis is needed to provide more specific advice.

Planting/Breeding advice:
For strawberry cultivation, it is recommended to select suitable cultivars that can tolerate high temperatures and have good heat resistance. Proper irrigation management is also crucial to maintain soil moisture and temperature. It is suggested to use mulching to conserve soil moisture and reduce soil temperature. Additionally, providing partial shade to the plants during the hottest part of the day can help to mitigate heat stress.

Pest control:
The specific environmental data provided does not give enough information to provide specific pest control recommendations. However, it is recommended to monitor for common pests that affect strawberries, such as spider mites, aphids, and thrips, and use appropriate control measures if necessary.

Copy Message Try Again

Commercialized Research Project: Carbon Monitoring System with Institute of Atmospheric Physics, Chinese Academy of Science



Monitoring

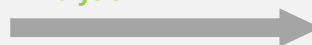
- Ground: Network of ground compact weather stations
- Air: Drones, Aircraft
- Space: Carbon Satellite: TanSat, GOSAT2, OCO3



Simulation

- Atmospheric Transport: WRF-CO2
- Ground Carbon Sources and Sinks: VEGAS/TRENDY
- Model Assimilation: LETKF-C, CarbonTracker

Simulator Model: Data Analysis

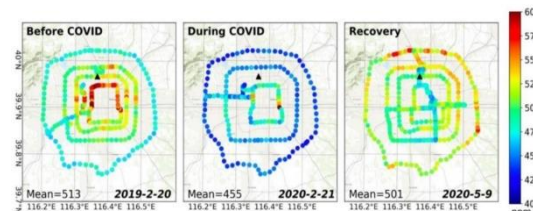
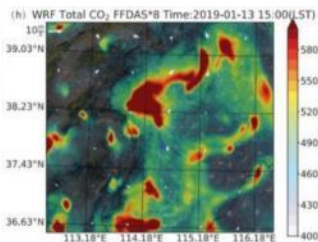
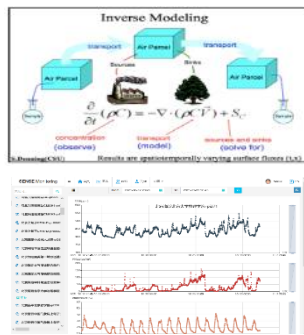


Dashboard: Data Visualization



Industry

- Emission reduction policy in the making
- Construction of carbon emission accounting model
- Standard reference for comprehensive atmospheric control
- Building a comprehensive information platform
- Research and historical data sources



Data Collection with reliable and high-precision monitoring weather station from Seeed (Co2 monitoring with the accuracy of 1% in ppm)

Modeling Assimilation System: Data Processing and Analysis

High Resolution Simulation of Carbon Sources and Sinks in Beijing-Tianjin-Hebei City Cluster

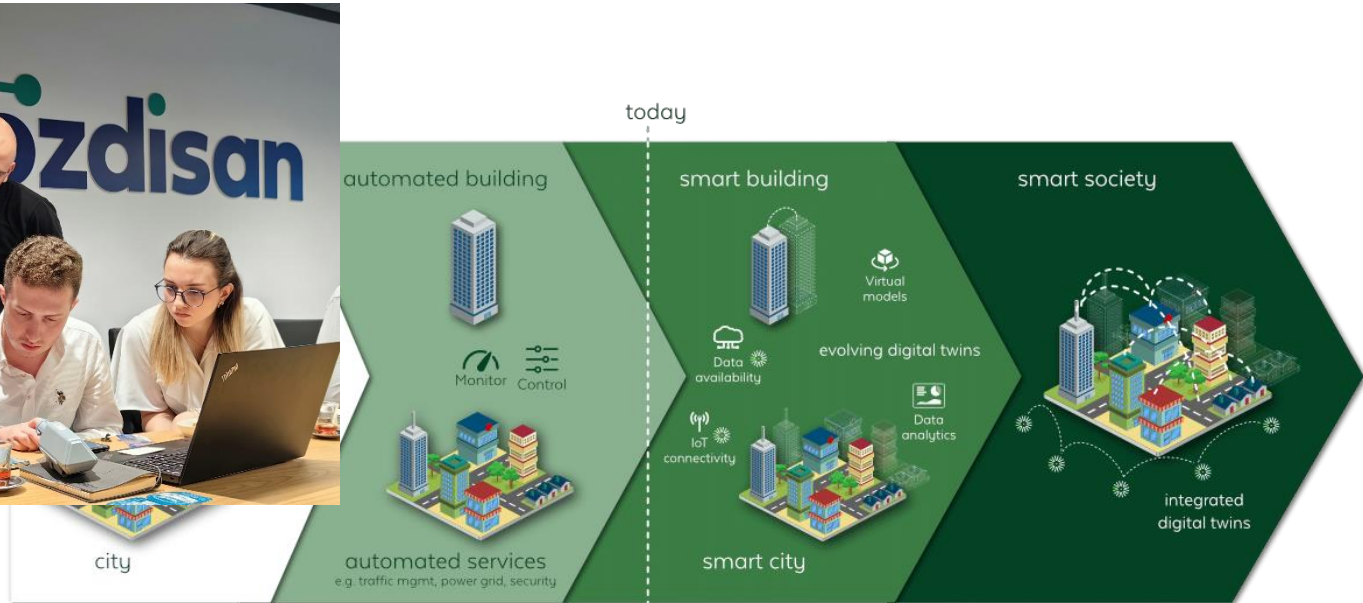
According to the system, the average CO2 concentration of Beijing's roads decreased by 40~60ppm

Train local solution makers with confidence

seeed studio

Digital Transformation 101

Build your first perception system in 8 hours



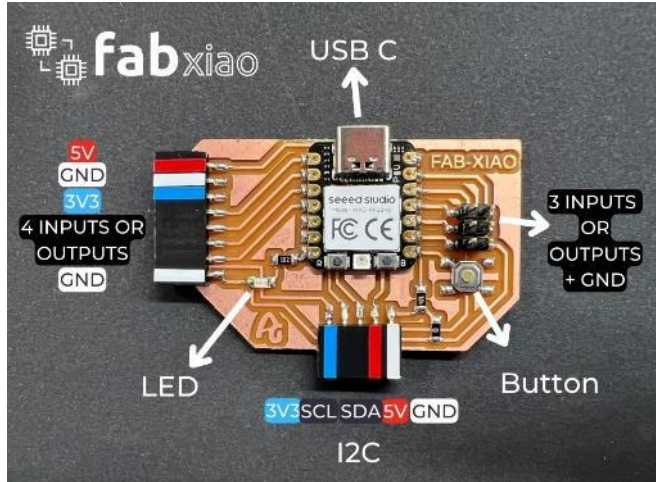
XIAO in Fab Academy & Fab Labs



The Fab Lab Network is a global community of makers, located in 90+ countries with 1,500+ Fab Labs. They share tools and knowledge to democratize technical invention and foster innovation.

FabXIAO

XIAO is the Designated Official Teaching Tool Recommended by Prof. Neil Gershenfeld, the Founder of the Global Network of Fab Labs.



FabLab Kannai - Fab Academy 2022

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Waag925
Basics of XIAO Series
Xiao_RP2040 Dual I2C-Bridge board

Basics of XIAO Series

Xiao seriee

Seeed Studio XIAO Series Comparison Table

| Board Name | Microcontroller | Flash Memory | RAM | GPIO | UART | I2C | USB |
|--------------|-----------------|--------------|-------|------|------|-----|-----|
| XIAO RP2040 | RP2040 | 2MB | 264KB | 30 | 1 | 1 | 1 |
| XIAO ESP32C3 | ESP32C3 | 4MB | 520KB | 38 | 1 | 1 | 1 |
| XIAO SAMD21 | SAMD21 | 512KB | 32KB | 18 | 1 | 1 | 1 |
| XIAO ESP8266 | ESP8266 | 4MB | 512KB | 33 | 1 | 1 | 1 |
| XIAO ESP32S3 | ESP32S3 | 4MB | 520KB | 38 | 1 | 1 | 1 |
| XIAO ESP32S2 | ESP32S2 | 4MB | 520KB | 38 | 1 | 1 | 1 |
| XIAO ESP32S1 | ESP32S1 | 4MB | 520KB | 38 | 1 | 1 | 1 |
| XIAO ESP32 | ESP32 | 4MB | 520KB | 38 | 1 | 1 | 1 |
| XIAO ESP8266 | ESP8266 | 4MB | 512KB | 33 | 1 | 1 | 1 |
| XIAO ESP8266 | ESP8266 | 4MB | 512KB | 33 | 1 | 1 | 1 |
| XIAO ESP8266 | ESP8266 | 4MB | 512KB | 33 | 1 | 1 | 1 |

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Seeed Studio Xiao RP2040
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Pinout/Board
Arduino Board
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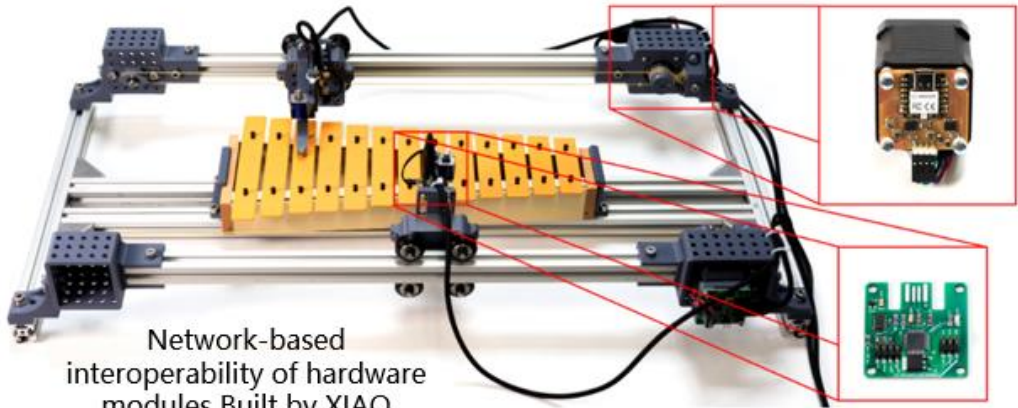
Week 4 group assignment Embedded programming Introduction to the platforms



Picture 1: Different platforms RP2040, ESP32C3, SAMD21

Introduction

During the [Instructor Bootcamp in Amsterdam](#), we recommended starting with the [Seeed Studio Xiao](#), specifically the RP2040 model or the ESP32C3. In my case, the Fab Lab uses the [Seeed Studio Xiao RP2040](#) model. The Fab Lab can also use the [Seeed Studio Xiao ESP32 C3](#).



Network-based interoperability of hardware modules Built by XIAO

seeed studio

Make Sense of the Wild



Discord
discord.seeed.cc



Project Hub
hackster.io/seeed



LinkedIn
[@Seeed Studio](https://www.linkedin.com/company/seeed-studio)



YouTube
[@Seeed Studio](https://www.youtube.com/seeedstudio)



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Let's talk!
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