GLOBAL OPEN TECH COMMUNITIES
OPEN SOURCE INNOVATION
AGILE MANUFACTURING
SCALABLE SOLUTIONS
SUSTAINABILITY

TinyML for SDGs

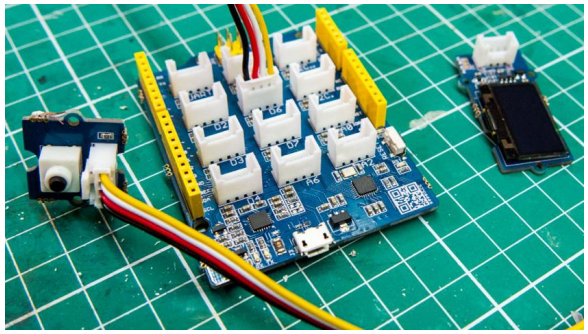
Ying CAI (Ellie)

Brand & Community Manager at Seeed Studio & Chaihuo Makerspace

Updated as of 2024/04

seeed studio

seeed studio



How it started since 2008

From possibilities to productivities

How it's going 2023

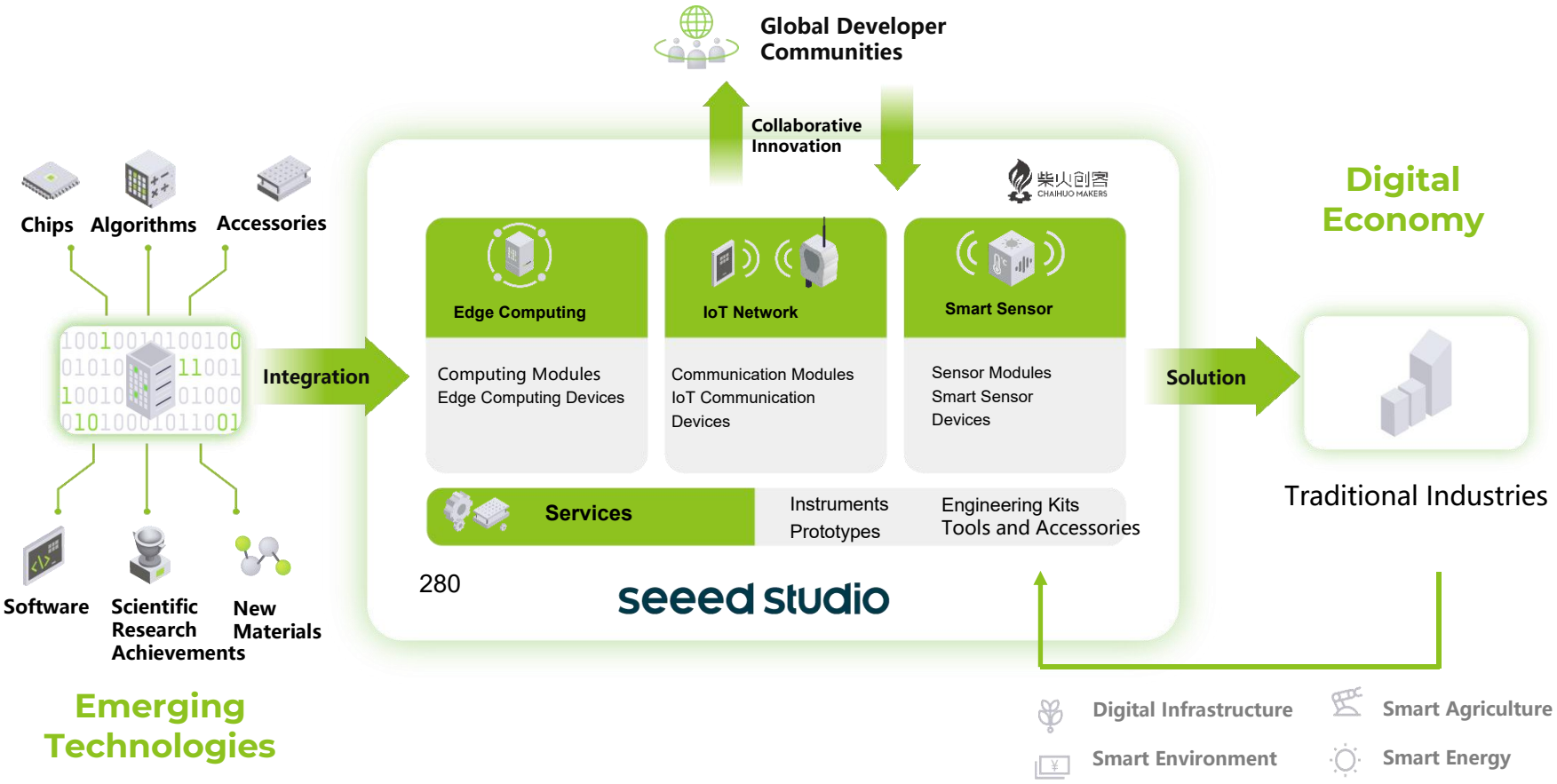
open source hardware

Smart Sensors
- Collect data -

Long range network
- Move data -

Edge computing
- Process data -

Community Driven, Industry Oriented



“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

TinyML Case Studies

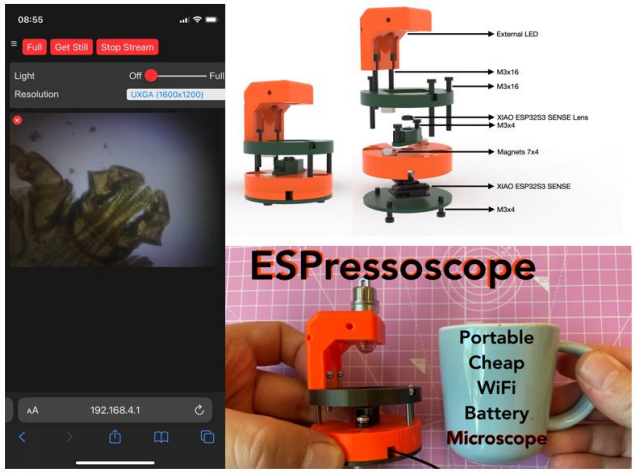
seeed studio

Community Project

1. OpenUC2 ESP32 XIAO Sense-Based Microscope

Microscopy is a vital tool in various scientific fields, but high-quality microscopes are often expensive and bulky. In September 2023, an open-source microscope called ESPressoscope, developed by Benedict Diederich and Vittorio Saggiomo, caught the attention of the community. This espresso cup-sized microscope, powered by the XIAO ESP32S3 Sense, can observe tardigrades, zooplankton, and microplastics. Seeed Studio partnered with OpenUC2, founded by Benedict, to create an affordable open-source modular microscopy toolkit. Seeed Studio and OpenUC2 also hope to make it a tool in underserved regions, with Benedict and his team currently engaged in a malaria detection project in Nigeria

This product is one of our upcoming licensed products, scaled up with Fusion Co-create and manufacturing services.



Seeed's hardwares used in this project:

XIAO ESPS3 Sense

Seeed's services used in this project:

Seeed Fusion Co-create Program

>>Read the full project in this blog

2. Benjamin Cabé' Artificial Nose

Thanks to Benjamin Cabé, now you can follow up the most comprehensive tutorial to build your AI-powered artificial nose that can differenciate coffee, tea, or identify whatever else you train it to smell. The Artificial Nose is powered by the Wio Terminal, Grove Multichannel gas sensor, and a TinyML neural network-based free online tool Edge Impulse.

Seeed's hardwares used in this project:

Tiny ML powered Artificial Nose Project kit with Wio Terminal

Softwares used in this project:

ARDUINO EDGE IMPULSE Azure

>>Read the full project in this blog

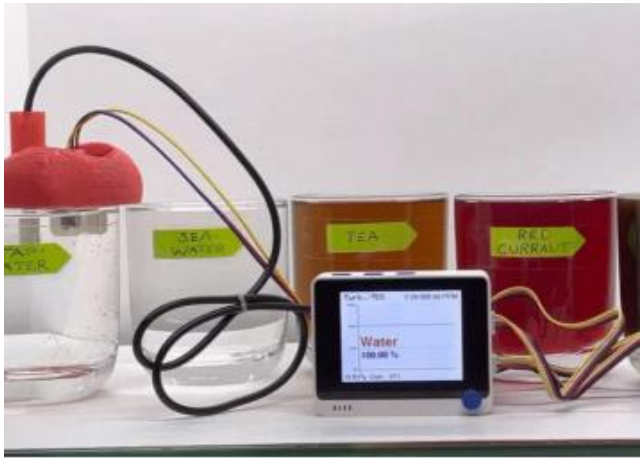
3 GOOD HEALTH AND WELL-BEING

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

17 PARTNERSHIPS FOR THE GOALS

3. Liquid Classification with TinyML

Inspired by Benjamin Cabé's artificial nose, Thomas Vikströmhas developed an electronic tongue capable of identifying various liquids. This innovation has several potential applications, such as in factory training for individuals who have lost their sense of taste and smell, wine testing, and water quality verification.



Seeed's hardwares used in this project:

Grove - TDS Sensor/Meter For Water Quality
Wio Terminal

Softwares used in this project:

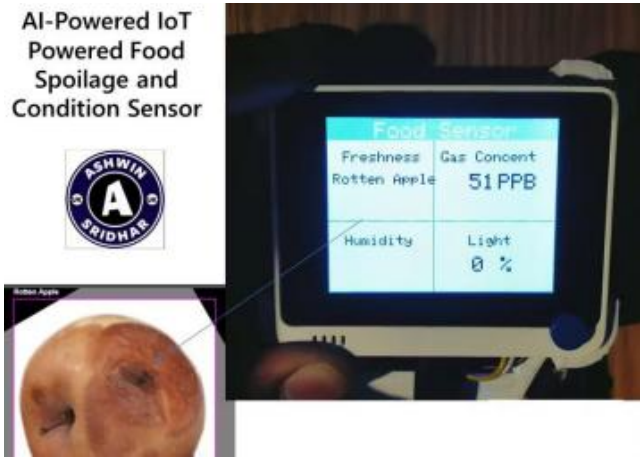
ARDUINO EDGE IMPULSE

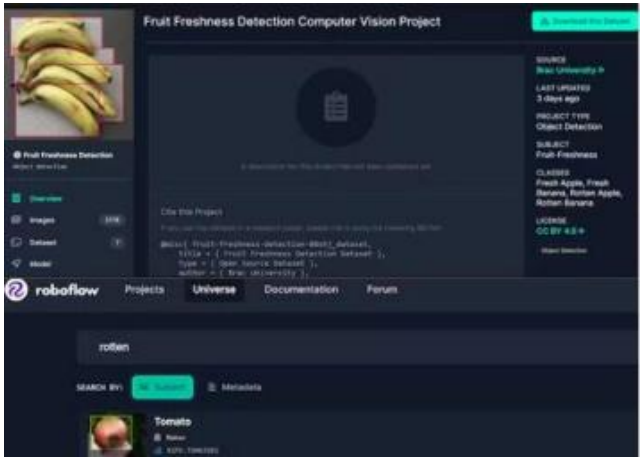
>>Read the full project on Edge Impulse

4. DeViridi: IoT Food Spoilage Sensor and Monitoring Dashboard

Smallholder farmers and supply chain actors in developing countries lose 15% of income due to food spoilage. This issue is compounded by the struggle to store and detect spoiled foods, resulting in high costs for farmers and processing companies.

Ashwin Sridhar developed a smart IoT device that uses AI-based image detection to monitor food storage conditions and detect spoilage early. By detecting the gas emitted by different types of food, the device can determine the progress and extent of food spoilage, allowing farmers, suppliers, supermarkets, and households to accurately assess food edibility.





Seeed's hardwares used in this project:

SenseCAP K1100 –The Sensor Prototype Kit with LoRa® and AI

Softwares used in this project:

ARDUINO AUTODESK FUSION 360 TensorFlow

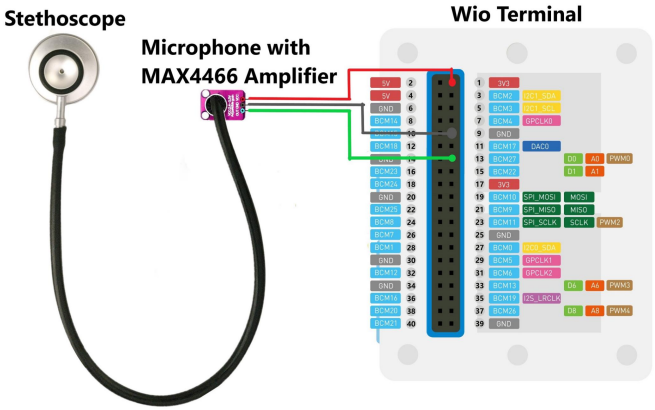
>>Read the full project on Hackster

Community Project

5. Smart Stethoscope Powered by Edge Impulse

A digital stethoscope that auscultates and detects abnormalities in the respiratory system using tinyML at the edge.

By leveraging Edge Impulse, the project enables the stethoscope to classify heart and lung sounds, providing real-time analysis and diagnosis. This innovation allows for more accurate and efficient detection of abnormalities in heart and lung functions, potentially revolutionizing the field of medical diagnostics.



Seeed's hardwares used in this project:

Seeed Studio Wio Terminal

Softwares used in this project:

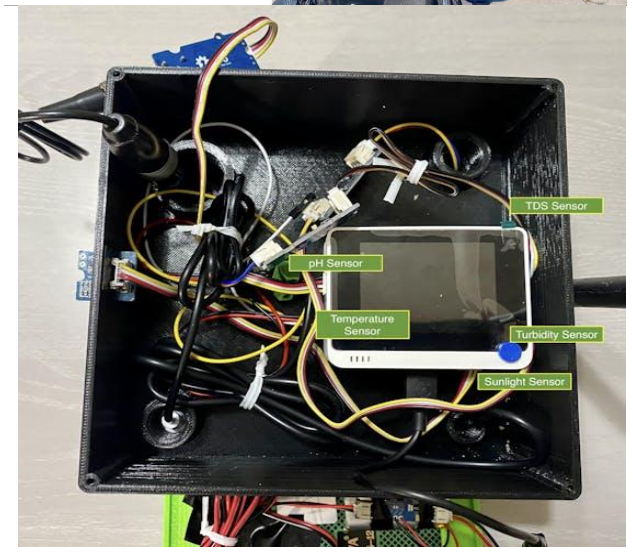
EDGE IMPULSE

>>Read the full project on Hackster

6. Smart Lake - Early Detection of Algae Bloom

Algae is the foundation of life on land and aquatic ecosystems, and the producer of 50% oxygen on Earth. However, due to the increased high levels of nitrogen and phosphorus in the water body, algae has been over-proliferating recently, and harmful algal blooms have been triggered. Since algae blooms produce harmful toxins that are detrimental to human and animal health, early detection of harmful algae blooms is necessary to prevent hazardous accidents.

This project used SenseCAP K1100 Kit to transmit the surrounding environmental data of harmful algae blooms to the AWS cloud through Helium Network. Simultaneously, the device runs a tinyML model to monitor real-time conditions of algae blooms in water bodies



Seeed's hardwares used in this project:

SenseCAP K1100 –The Sensor Prototype Kit with LoRa® and AI

Softwares used in this project:

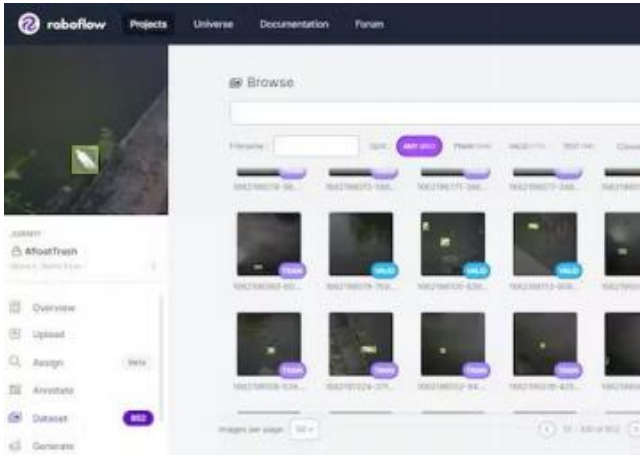
EDGE IMPULSE

>>Read the full project on Hackster

7. Plastic Bottle Detector For Lake

Plastic bottles/ containers are disposed of in the environment, leading to their inappropriate disposal in rivers, drains, lakes, and oceans. This has resulted in severe environmental pollution and poses a threat to the health and well-being of humans and other living organisms.

JuanYi has developed a device that utilizes vision to identify plastic bottles floating on a lake and sends the collected data to the cloud to minimize the negative impact of trash on the environment.



Seeed's hardwares used in this project:

SenseCAP K1100 – The Sensor Prototype Kit with LoRa® and AI

Softwares used in this project:

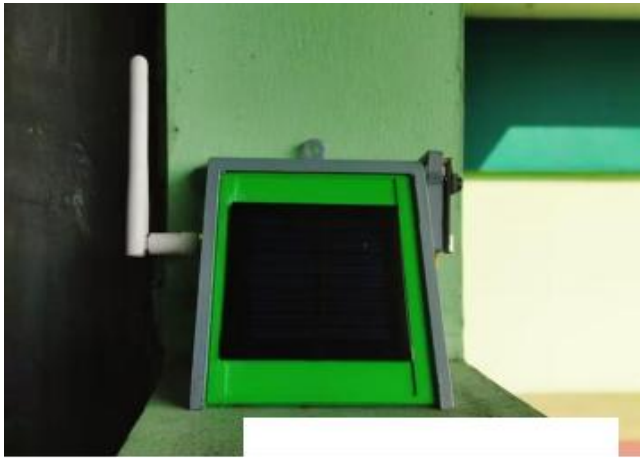
ARDUINO roboflow

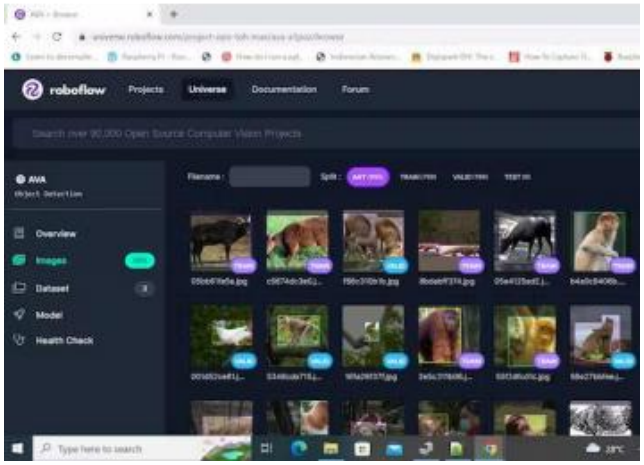
>>Read the full project on Hackster

8. Wildlife Sanctuary Monitor

Indonesia's tropical forests, the third-largest in the world, are home to diverse wildlife, including endangered species. However, conservation efforts face challenges such as illegal hunting and deforestation.

Hendra Kusumah has created a conservation tool that monitors the state of forests and identifies endangered animals as part of efforts to protect them. This project centers on utilizing audio classification to assess the vitality of endangered wildlife, with Grove-Vision AI employed to detect their movements. The device can alert authorities of illegal poaching activities and issue early warnings in the event of wildfire outbreaks to prevent their spread.





Seeed's hardwares used in this project:

SenseCAP K1100 – The Sensor Prototype Kit with LoRa® and AI

Seeed Studio XIAO RP2040

Softwares used in this project:

ARDUINO

EDGE IMPULSE

>>Read the full project on Hackster

9. IoT AI-driven Tree Disease Identifier w/ Edge Impulse & MMS

Due to environmental changes and extensive deforestation, trees and plants are becoming increasingly vulnerable to contagious illnesses. This is particularly concerning since trees play a critical role in pollination, and the spread of tree diseases can lead to significant crop yield losses, animal fatalities, widespread infectious epidemics, and even land degradation caused by soil erosion.

To address this issue, Kutluhan Aktar has developed a device that employs Grove-Vision AI to gather images of infected trees, thereby creating a comprehensive dataset. Using Edge Impulse, the models are trained and deployed to identify tree diseases at an early stage. The results are then communicated via MMS, enabling swift action to prevent further spread and harm to forests, farms, and arable lands.

Seeed's hardwares used in this project:

SenseCAP K1100 –The Sensor Prototype Kit with LoRa® and AI

Grove – CO2 & Temperature & Humidity Sensor (SCD30)

Softwares used in this project:

ARDUINO

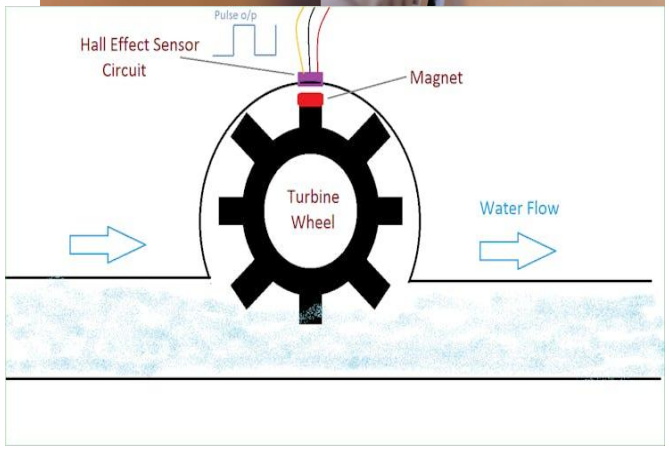
EDGE IMPULSE

>>Read the full project on Hackster

10. Pipeline Clog Detection with a Flowmeter and TinyML

Pipeline clogs can have serious and destructive effects on industrial operations. Clogs can occur for a variety of reasons, such as the build-up of debris, corrosion, and other types of damage. When a pipeline clogs, it can disrupt the flow of materials and lead to costly repairs, downtime, and other problems.

By analyzing flow rate data collected from the flowmeter, the system utilizes machine learning algorithms implemented on microcontrollers to identify anomalies indicative of pipeline clogs. This solution offers a cost-effective and efficient method for monitoring pipeline integrity and preventing potential disruptions in fluid flow systems.



Seeed's hardwares used in this project:

Seeed Studio Wio Terminal

Softwares used in this project:

EDGE IMPULSE

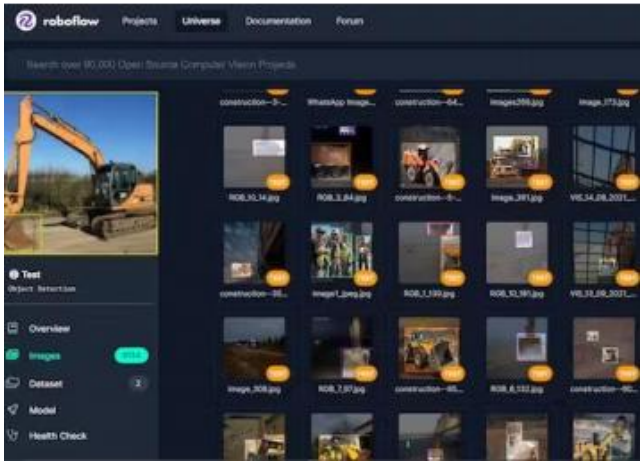
ARDUINO

>>Read the full project on Hackster

11. Vision based Sand Depletion Prevention Kit (VSDP)

Sand mining from riverbeds is a major environmental issue, leading to various negative impacts on rivers, including social, environmental, geomorphic, and disastrous impacts. Unchecked sand consumption could increase by 45% in four decades, leading to environmental damage and urban expansion material shortages.

To address this issue, Rahul Khanna D has designed a system that uses Grove sensors to process sensor data, such as VOC, eCO2, soil moisture, temperature, and humidity. This device monitors trespassing humans in the sand depletion region and notifies the server via the gate way. Additionally, the Edge AI model monitors illegal sand mining using the Grove-Vision AI Module. Multiple AI nodes are deployed and connected to the LoRaWAN® gateway, which connects to the Helium Server.



Seeed's hardwares used in this project:

SenseCAP K1100 –The Sensor Prototype Kit with LoRa® and AI

Softwares used in this project:

ARDUINO helium

>>Read the full project on Hackster

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
11 SUSTAINABLE CITIES AND COMMUNITIES
17 PARTNERSHIPS FOR THE GOALS

12. Early Flash Flood Warn System

Floods are a type of natural disaster that can be both common and costly. They are often caused by hurricanes, melting snow, or prolonged periods of rain. Flash floods can occur suddenly when water rapidly rises along a stream or low –lying area.

Jhonattan Fredy Moreno Bernal has created a project to tackle this problem by developing a low-cost system for generating early warnings. By deploying a network of nodes, the system is able to monitor water flows and gather more information to build predictive flood models. The system utilizes a trained model to detect sudden floods and sends an alarm through the Blynk platform via email when a defined detection threshold is exceeded. This helps provide timely alerts for taking preventive measures against floods.

Seeed's hardwares used in this project:

SenseCAP K1100 –The Sensor Prototype Kit with LoRa® and AI

Softwares used in this project:

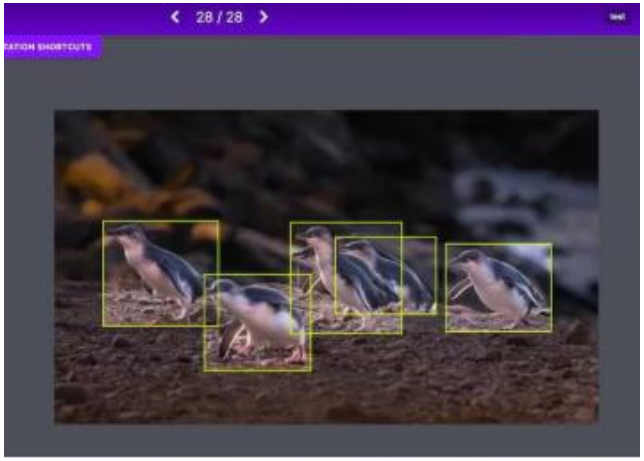
Blynk roboflow

>>Read the full project on Hackster

13. Penguin Counting and Monitoring

Over the past few years, ocean species have been adversely affected by marine pollution and marine heatwaves, leading to starvation and mass deaths. The little blue penguin, also known as “Kororā,” is particularly vulnerable to these conditions, with New Zealand’s Department of Conservation (DOC) categorizing them as “declining/at risk.”

To address this critical issue, Richard Wright has developed a system using the Grove-Vision AI Module to detect, monitor and protect penguins when they come ashore and send the notification via LoRa®. However, this task is quite challenging as penguins typically come ashore at dusk when it is too dark to capture them, but Richard Wright believes that it is a crucial and ongoing endeavor that people must undertake.



Seeed’s hardwares used in this project:

SenseCAP K1100 –The Sensor Prototype Kit with LoRa® and AI
Wio Terminal Chassis
Wio Terminal Chassis –Battery

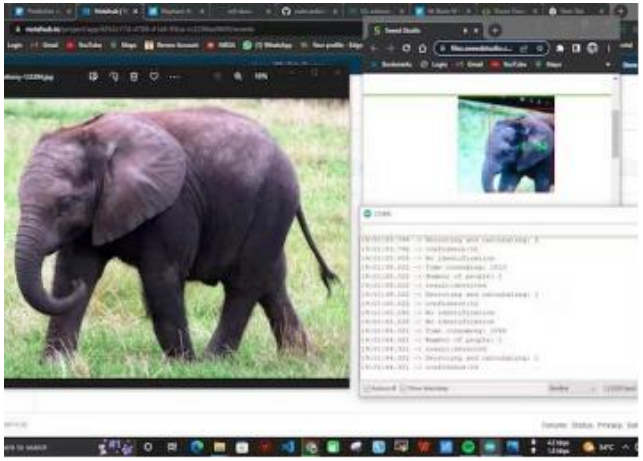
Softwares used in this project:

ACODE

14. Gate Keeper –An IoT Based Elephant Detection System

Located in southern India, Ooty is a picturesque hill known for its scenic beauty. However, the frequent entry of elephants into the area often causes panic among the residents. While the sounds of these giant mammals sometimes alert the locals, they usually remain silent, posing a significant risk of human-elephant conflict.

To mitigate this issue, Pradeep Thiruna and his team developed an IoT-based Elephant Detection System using the SenseCAP K1100 – The Sensor Prototype Kit with LoRa® and AI. They integrated the Grove-Vision AI Module to detect and monitor elephant activities and promptly alert the residents via SMS or email.



Seeed's hardwares used in this project:

SenseCAP K1100 –The Sensor Prototype Kit with LoRa® and AI

Softwares used in this project:

ARDUINO Qubitro blueswireless

>>Read the full project on Hackster

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
15 LIFE ON LAND
17 PARTNERSHIPS FOR THE GOALS

15. Detect the Drain Blockage with Tiny ML + LoRa®

Shuyang's office has a lovely balcony that resembles a peaceful garden during spring and summer with blooming flowers and plants. However, fallen petals and leaves can quickly accumulate and clog the drain, causing problems.

Shuyang wants to find a way to detect debris accumulation and receive alerts for timely action. To overcome challenges in installing sensors on the balcony and limited knowledge of coding and TinyML, Shuyang used a no-code solution with an outdoor smart image sensor that performs local inference and transmits results with LoRa®. Edge Impulse assisted with model training.

Seeed's hardwares used in this project:

·SenseCAP A1101 –LoRaWAN® Vision AI Sensor

Softwares used in this project:

EDGE IMPULSE

>>Read the full project on Hackster

Useful Links

- **Train and Deploy Your Own AI Model Into Grove -Vision AI Module**
  https://wiki.seeedstudio.com/Train-Deploy-AI-Model-Grove-Vision-AI/
- **HIMAX Yolo-Fastest Person Detection Example For Seeed Grove -Vision AI Module**
  https://github.com/HimaxSmartSensing/WE_I_Plus_User_Examples/tree/main/HIMAX_Yolo_Fastest_Person_Detection_Example_For_Grove_AI
- **Edge Impulse's Official Support for Grove-Vision AI module**
  https://docs.edgeimpulse.com/docs/~/revisions/WOgRGOTQBrFnmbtextkF/development-platforms/officially-supported-mcu-targets/seeed-grove-vision-ai
- **Train and Deploy Your Own AI Model Into SenseCAP A1101**
  https://wiki.seeedstudio.com/Train-Deploy-AI-Model-A1101/
- **Train a meter reading detection model with existing dataset**
  https://github.com/Seeed-Studio/Edgelab
- **Quick Start with SenseCAP K1100 -The Sensor Prototype Kit**
  https://wiki.seeedstudio.com/K1100-quickstart
- **Quick Start with SenseCAP K1100 -The Sensor Prototype Kit**
  https://wiki.seeedstudio.com/K1100-quickstart
- **TinyML on Seeed Studio XIAO Series**
  https://wiki.seeedstudio.com/Seeeduino-XIAO-TinyML
- **TinyML on SEEED XIAO RP2040 (Motion Recognition)**
  https://wiki.seeedstudio.com/XIAO-RP2040-EI
- **Seeed Studio XIAO nRF52840 Sense Edge Impulse Getting Started**
  https://wiki.seeedstudio.com/XIAOEI
- **Speech Recognition on Seeed Studio XIAO nRF52840 Sense**
  https://wiki.seeedstudio.com/XIAO-BLE-Sense-TFLite-Mic

IoT2Wild Products
@For NGOs & IOs
@For Companies

Open Tech Project Hub
hackster.io/seeed

LinkedIn
@Seeed Studio

Twitter
@seeedstudio

Discord
discord.seeed.cc

YouTube
@Seeed Studio

Let's Talk! :)

ellie.cai@seeed.cc

Grow the Sustainable Impacts with

seeed studio