

# Project Repository of IoT Into the Wild Contest for Sustainable Planet 2022



# Publishment Details

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# List of Symbols and Acronyms



<b>ACQ</b>	Acquisition
<b>AI</b>	Artificial Intelligence
<b>AIoT</b>	Artificial Intelligence of Things (AI + IoT)
<b>BSF</b>	Black Soldier Fly
<b>CNC</b>	Computerized Numerical Control
<b>CNN</b>	Convolutional Neural Networks
<b>CXO</b>	Chief Experience Officer
<b>EC</b>	Electrical Conductivity
<b>FGASA</b>	Field Guides Association of Southern Africa
<b>FOMO</b>	Faster Objects, More Objects
<b>GAP</b>	Global Average Pooling
<b>GHGs</b>	Greenhouse Gases
<b>GOES</b>	Geostationary Operational Environmental Satellites
<b>IAAC</b>	Institute for Advanced Architecture of Catalonia
<b>IoT</b>	Internet of Things
<b>IoT2Wild Contest</b>	IoT Into the Wild Contest for Sustainable Plant 2022
<b>KPIs</b>	Key Performance Indicators
<b>mAP</b>	Mean Average Precision
<b>ML</b>	Machine Learning
<b>ORP</b>	Oxidation–Reduction Potential
<b>R&amp;D</b>	Research and Development
<b>SDGs</b>	Sustainable Development Goals
<b>STEM</b>	Science, Technology, Engineering, and Mathematics
<b>tinyML</b>	Tiny Machine Learning
<b>TTN</b>	The Things Network
<b>UHF RFID</b>	Ultra–High Frequency Radio–Frequency Identification

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# I. Why IoT2Wild Contest?

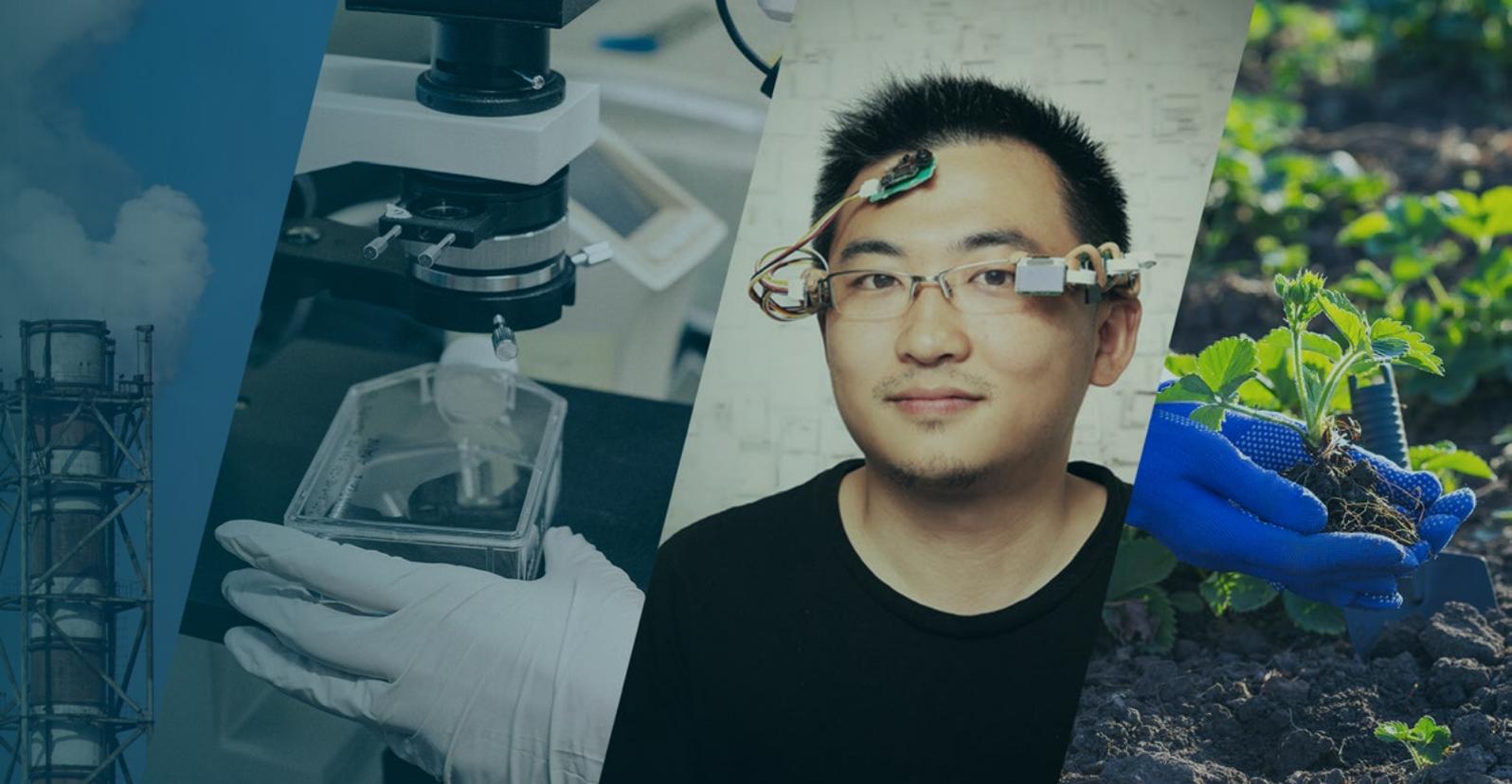
In this contemporary era, our humanity is increasingly recognizing the indivisible, delicate, and complicated relationship among humans, animals, biodiversity, and the environment. As our environmental habitats, endangered animals, and climate crisis are threatened by the costs of our own actions on this planet, it is all the more serious and necessary than ever before, for us to come together to undertake emergency actions for our real-world. Indeed, as Dr. Gro Harlem Brundtland, the Former Chair of the UN's World Commission on Environment and Development and Former Director-General of WHO shared,

“Globalization has shrunk ... distances, broken down old barriers, and linked people together. Globalization has also made problems halfway around the world your problem: everyone's problem. And it has also made, around the world, something that we need to tackle seriously, that we cannot just see as kind of a film on a TV screen. It relates to all of us.”

Moving on with this trend, emerging technologies like the Internet of Things (IoT) and Artificial Intelligence (AI) have been increasingly receiving significant attention and recognition from multi-stakeholders as a 'new toolset' to obtain real-time and chronological data on every element we need from the wild and the environment. Why? For their accessibility, affordability, bottom-up innovation, resource efficiency, and sustainability features.

However, there's a serious gap between conservation landscapes and technological applications. Up until now, open source technologists, glocal maker communities, and field experts (scientists, environmentalists, conservationists) have been working in silos most of the time. In consequence, the world is seriously lacking applicable, scalable, plug-and-play, and easy-to-deploy AIoT (AI + IoT) solutions that can be helpful for solving challenges in the wild.

To bridge the gap, Sseed Studio and Hackster.io jointly organized "IoT Into the Wild Contest for Sustainable Plant 2022" ('IoT2Wild Contest' for brevity) from June 8th to October 11th, which is supported by 14 partner organizations ranging from tech companies, maker space, social



enterprises, academia, NGO: Project 15 from Microsoft, Chaihuo x.factory, Semtech, Zambezi Partners, Edge Impulse, Hackster.io, Fab City Foundation, Institute for Advanced Architecture of Catalonia (IAAC), the Paradise International Foundation, Nova Labs, Helium Foundation, SOSV, HAX, and Himax Technologies.

As a result of this Contest, we received 122 Project Submissions, gave away 104 free hardware kits, and inspired 561 Participants from 78 Countries in 6 continents. On October 11th, winners of the IoT2Wild Contest were announced online at Hackster.io's Impact Summit 2022. As a result, 31 winners have been selected as final winners for 6 types of Awards. In fact, during the Winner Announcement, we also announced a surprise award called "Facilitator Award" – that's given to the people who manifested the spirit of the global open source community through demonstrating an exceptional facilitator role by voluntarily and passionately sharing their technical and non-technical knowledge, skills, and know-hows. The prize for this award consists of swags from Seeed Studio, Helium, Nova Labs, and Zambezi Partners.

We believe that open tech can leverage more positive transformations for our ultimate pursuit: harmony of nature, humans, animals, and biodiversity. We hope that open tech – defined by a set of principles for decentralized innovation, transparency, collaboration, community-spirit, agile prototyping and scale-ups – can lay an important foundation for accelerating the achievement of the UN's 2030 Agenda of the Sustainable Development Goals (SDGs).

Eric Pan,  
Founder and CEO,  
Seeed Studio



## II. What Are the Challenge Topics?

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

In the IoT2Wild Contest, there were 5 challenges in total, among which the participants were able to freely choose one challenge or combine several sub-challenges, and make easy-to-deploy AIoT solutions. The 5 challenges and their sub-challenges were:

### Challenge 1: Climate Crisis Prevention/Mitigation

- Global warming
- Carbon neutrality
- Natural disaster prevention/mitigation
- Sand depletion crisis
- Environmentally-unsustainable tourism mitigation

### Challenge 2: Wildlife/Biodiversity Conservation (Unlimited to Various Types of Flora and Fauna)

- Non-intrusive monitoring of endangered wildlife/biodiversity species from various threats
- Animal movement, behavior and emotion detection
- Environmental habitat monitoring
- Human-wildlife conflict prevention/mitigation

### Challenge 3: Marine Conservation

- Sea level rise
- Melting glaciers, ice, snow
- Marine pollution
- Harmful algal bloom
- Plastic pollution

### Challenge 4: Open Science

- Low-cost, open science hardware solutions as scientific research tools designed for outdoor scenarios in the wild (ex. microscopes, science equipment designs, sensors for environmental monitoring, etc.)

### Challenge 5: Sustainable Agriculture

- Climate-smart commodities
- Precision farming
- Smart animal husbandry
- Autonomous greenhouse
- Sustainable food supply chain management
- Local food production

# III. Who Are the Judges?



**Sarah Maston**

## **Founder of Project 15 from Microsoft & Director of Global Partner Development at Microsoft**

Sarah Maston is the Founder of “Project 15 from Microsoft”, and the Co-Inventor of “Project 15 Open Platform”. Her other inventions at Microsoft include an IoT solution called “Project Edison”, which is a safety notification accelerator for safe schools and workplaces – for which she won the “Microsoft Polaris Award”. In her 20-year career, she has architected many data warehouses out in the world, including those at Monster.com, CouchSurfing.com, and Boston Medical Center. Prior to joining Microsoft, she had won an “Excellence & Eminence Award” at IBM for the invention of “Nutrition Graph”, and an “Outstanding Innovation Award” for the invention of “Simple Data Pipe”.



**Eric Pan**

## **Founder and CEO of Seeed Studio and Chaihuo x.factory & Producer of Maker Faire Shenzhen**

Eric Pan is the Founder and CEO of “Seeed Studio” and “Chaihuo x.factory”, as well as the Producer of “Maker Faire Shenzhen”. He believes in the potential of open source technology and social innovations in achieving the UN’s SDGs. Moreover, he is one of the recognized leading figures of the Maker Movement and Maker Culture in China. In the era of the UN’s 2030 Agenda, he is keen on cooperating with multi-stakeholders and technical partners to provide open source solutions for a variety of SDGs-related projects, through which groundbreaking solutions can be co-created and scaled up at global level so as to contribute to a sustainable future. In 2013, he was selected by Forbes Magazine as “China’s 30 Entrepreneurs Under 30” and appeared on the cover of the Forbes China. Likewise, he was listed on “2017 China’s Business List of 100 Creative People”.



**Andy Gan**

### **Director of LoRa China Business Development at Semtech**

Andy Gan is the LoRa Business Development Director of Semtech in China. He has a solid background of IoT chip R&D and application development. When working at Hong Kong University of Science and Technology, he participated in several major projects related to Ultra-High Frequency Radio-Frequency Identification (UHF RFID) IoT chips. After that, he joined Nations Technologies Inc., and then Alien Technology Corporation. Now, he is working at Semtech, and is responsible for LoRa's application development in China. Furthermore, he used to be one of the key members of China RFID Industry Alliance, as well as China's RFID Standard Working Group, and IoT Standard Working Group and Sensor Network Standard Working Group. Currently, he is an expert in Shanghai IoT Association, Shenzhen RFID Standard Alliance, and Shenzhen IoT Industry Association. Last but not least, he published a couple of books, and owns more than 10 patents.



**Bastiaan den Braber**

### **Founder of Zambezi Partners**

Bastiaan den Braber is the Founder of Zambezi Partners. In 2003, when he first went on safari trips in Africa, he had the vision to use the best of the world's technologies – in combination of entrepreneurship and investment – to combat African wildlife poaching. Thereby, he became a Field Guides Association of Southern Africa (FGASA) Level 1-trained Field Guide as a part of this journey, and formally devoted his life bringing together the technology partners for Zambezi. Zambezi Partners is a fifth industrial revolution, AIoT solution company with a well-managed platform for sustainability known as "Platform Zero", and is Microsoft's first commercial partner of the Project 15 Open Platform. Furthermore, Zambezi works with conservation organizations and for-profit sustainability entities to institute data-driven, exponential technologies to drive scalability and efficacy in solving the world's most complex issues.



**Peng Zhao**

### **Senior Consultant of the Paradise International Foundation**

Peng Zhao is the Senior Consultant of the Paradise International Foundation. Since 2005, he has led several influential initiatives in the field of ecological and environmental protection in China, including "China's Biodiversity Conservation Strategy and Action Plan" published by the State Council; creation of China's first land trust preserve, which has been identified as the innovative conservation model by the Ministry of Natural Resources, and; establishment of China's first water fund for rural areas and mega cities for water source protection. In addition, he extended the conservation focus to the urban, marine and carbon neutral sectors.



**Adam  
Benzion**

### **Chief Experience Officer (CXO) at Edge, & Co-Founder of Hackster.io**

Adam Benzion is the CXO at Edge Impulse, a Co-Founder of Hackster.io, a Microsoft alumni, a recovered hardware entrepreneur, and an investor. His expertise lies in building meaningful technological solutions that can solve pressing challenges of our time – such as wildlife and environmental preservation, by means of using open source principles and community-building initiatives. From time to time, he enjoys writing for Fast Company, Power Magazine, TechCrunch, EE Times, and The Next Web.



**Travis L.  
Teague**

### **Developer Growth Lead at Nova Labs**

Travis L. Teague is the Developer Growth Lead at Nova Labs. He has an extensive background in embedded systems, enterprise and mobile software, as well as IoT solutions. Moreover, he was the Co-Founder and Technical Lead of a handheld medical device company, and is an active leader in Houston-based training initiatives on IoT and STEM (Science, Technology, Engineering, and Mathematics). His first machine was a TI-99/4A, which inspired him to continue playing with hardware. Until the present day, one will find his house filled with Computerized Numerical Control (CNC), microcontrollers, drones, and radios scattered across every surface.



**Joey Hiller**

### **Technical Director at Helium Foundation**

Joey Hiller is the Technical Director at Helium Foundation. He works across a wide area of The People's Network's ecosystem – from sensor applications to network analysis, and expansion to other protocols. Prior to joining Helium Foundation, he was an early adopter of the “Helium Coverage Mapping” project as a grantee and a community member.



**Cyril  
Ebersweiler**

### **General Partner at SOSV & Founder and Managing Director of HAX**

Cyril Ebersweiler is a General Partner at SOSV (a global venture capital firm that offers multi-stage investment, starting with pre-seed startup development), and the Founder and Managing Director of HAX. He is an experienced investor in deep tech and has invested globally. Moreover, he is a Board Member and an advisor to a few startups including Formlabs, AngelList, Adoreme, Collaborate (ACQ: CISCO), Hackster.io (ACQ: AVNET), Dispatch Robotics (ACQ: AMZN), Makeblock, Yeelight, Particle, Opentrons, Bartsian, Avidbots and Simbe Robotics. Furthermore, he is a popular speaker at international events (TC Disrupt, Collision, Pioneers, MIT Forum, etc.), university events (Stanford University, UC Berkeley, etc.), and an author of dozens of articles on topics as technology, robotics, health and crowdfunding. He is often featured in The Economist, Popular Mechanics, The New York Times, Bloomberg, Huffington Post, Wired, BBC, and more.



**Tomas Diez  
Ladera**

**Founding Partner and Executive Director of the Fab City Foundation  
& Co-Director and a Board Member of the IAAC**

Tomas Diez Ladera is a Venezuela-born Urbanist, who specializes in digital fabrication and its implications in the future of cities and societies. He is the Founding Partner and Executive Director of Fab City Foundation, and Meaningful Design Group Bali. Furthermore, he is a Co-Director and a Board Member of the Institute for Advanced Architecture of Catalonia (IAAC), where he also works as a Senior Researcher and a tutor. Moreover, he is the Co-Director of the “Masters in Design for Emergent Futures” and the “Masters in Design for Distributed Innovation”. On this backdrop, he collaborates with trans-sectoral partners for joint projects, events, and programs with Fab Foundation worldwide, such as, Fab City, Fab Conferences, and Fab Academy, to mention a few.

# IV. What Are the Winners' Projects?

## Excellent Sustainable and Scalable Project Award

Smart Lake - Early Detection of Algae Bloom

## Innovative and Creative Project Award

AgroLoRa

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

Weather Balloon "Mining" Using Blockchain and IoT

Study of Animal Movement: Equipment Design and Development

MonSand: Monitoring Illegal Sand Mining

## Enthusiastic Project Award

Wildlife Sanctuary Monitor

DeViridi: IoT Food Spoilage Sensor and Monitoring Dashboard

Smart UV Meter

Black Soldier Fly Farming – Creating Protein Content

Monitoring Health of a Wind Turbine in 3D

Penguin Counting and Monitoring

POWAR v2.0 - WIO Terminal

Wireless Monitoring System for GHGs Emissions in Paddy Field

NOMOS: Mosquito Growth Monitoring System

Plastic Bottle Detector For Lake

## Best Helium Award

AgroLoRa

## Helium Award

MonSand: Monitoring Illegal Sand Mining

Smart UV Meter

Monitoring Health of a Wind Turbine in 3D

NOMOS: Mosquito Growth Monitoring System

FarmBOX

Fight Fire – Wild Fire Prediction Using TinyML

Project Agouti

Edible Algae Growing Cycle Monitor

Volcano Activity Monitoring System for Residents and Climber

Trail Conservation NFT



Excellent Sustainable  
and Scalable Project Award

seed studio

# Smart Lake - Early Detection of Algae Bloom

Project Makers: Mithun Das, Sashrika Das

Sustainability Topic: Natural Disaster Prevention and Mitigation



*“Something very tragic happened recently in our town. A dog parent took her dog to a lake for a swim. She did not notice there were algal blooms. On the way back home, the dog started panting, [and then she] was taken to emergency immediately, but could not survive. :( Wish the parent knew the lake has toxins, and [so she] could [have] avoided the swim. We are designing a device equipped with multiple sensors to detect the presence of algae in the water and provide real-time updates to town residents. ... so that they can avoid such incidents.”*

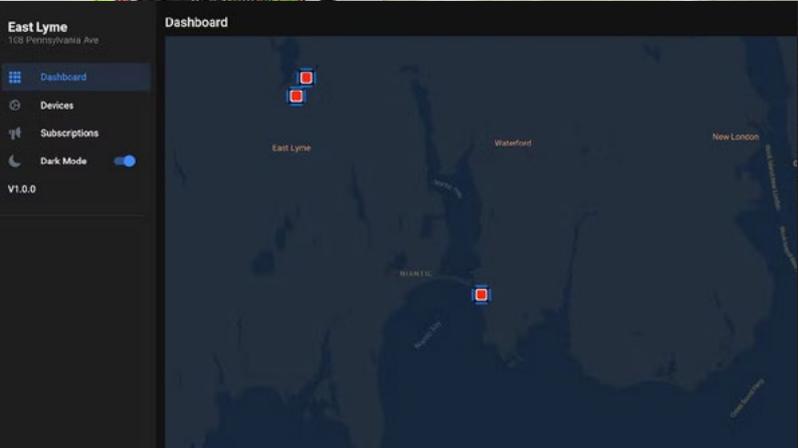
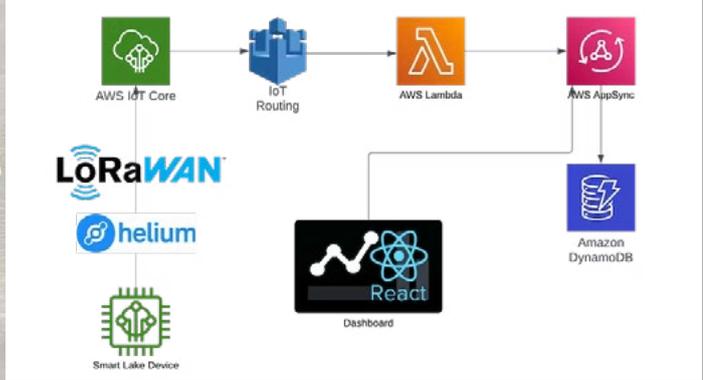
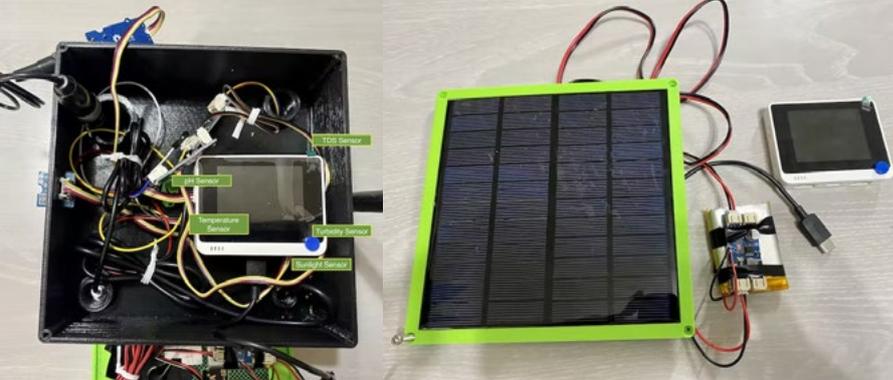
— Mithun Das, Sashrika Das

## CHALLENGE

Algae is the foundation of life on land and aquatic ecosystems, and the producer of 50% of 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.

## METHODS

This project used Wio Terminal and a variety of Grove sensors (pH, TDS, turbidity, temperature, light) from [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 (A= Normal; B= Warning; C = Danger). The goal is to collect as much data as possible, both with and without algae, so that the device can be trained to make a thorough harmful algae detection model for accurate predictions.



## RESULTS

Governmental authorities and residents living nearby lakes, waterbodies, and coastal areas can receive the analyzed, real-time, and chronological data on the status quo of algae blooms. This information can be helpful for generating early warnings, arranging water maintenance, and preventing negative externalities from happening.

## RESOURCES NEEDED FOR SCALE-UPS

- Industrial-grade SenseCAP sensors
- Local field implementation partners
- On-site field travel support

## LEARN MORE

[https://www.hackster.io/mithun-das/smart-lake-early-detection-of-algae-bloom-6494c9?auth\\_token=c93712b112c9c352b183cb1f80c0a67c](https://www.hackster.io/mithun-das/smart-lake-early-detection-of-algae-bloom-6494c9?auth_token=c93712b112c9c352b183cb1f80c0a67c)

## CONTRIBUTE

Mithun Das (mithundotdas@gmail.com)



# AgroLoRa

Project Makers: **Luis Eduardo Arevalo Oliver, Victor Altamirano**  
Sustainability Topic: **Precision Farming**



*“If we want to have the most impact with a project regarding ... water sustainability, we have to focus on the industry that requires more of it, which is ‘agriculture’. ... Most countries have their periods of drought, but as years become even hotter because of climate change, drought greatly affects several regions. California is an example of this. ... Industry 4.0 tools and automation are greatly needed. ... LoRa technology has been chosen because the characteristics of long-range and low-power are excellent for remote areas and cities alike.”*

– Luis Eduardo Arevalo Oliver, Victor Altamirano

## CHALLENGE

Local and urban farming is increasingly gaining spotlights as an alternative agriculture technique to move forward towards sustainable food supply chains, fulfill the growing population’s nutrition needs, and keep up with global trends on favoring organic food produce. However, adoption rate of IoT and other Industry 4.0 technologies remains lower than what is desired, due to many constraints. Therefore, local and urban farming should be upgraded with a low-cost and readily available technological solutions, for it to be sustainable.

## METHODS

This project’s prototype is an automated irrigation and crop health monitoring device for local and urban farming, which is developed on the basis of [SenseCAP K1100 Kit](#), that can perform predictive analytics to save water. First, from the Kit, they employed Grove – Temperature & Humidity Sensor, and Grove – Soil Moisture Sensor to obtain atmospheric and soil data. Second, they developed a dashboard to add notification features via Openweathermap API and [Node-RED](#). Third, in order to send the collected data, they connected the sensors with the nearest LoRa gateway through [Helium](#) network. Fourth, when all the data has been gathered, it is transferred to a web application, in order to produce databases on crop health, growth, and yield, conduct data analysis to feed the findings into predictive AI analytics, and automate irrigation systems based on the congregated data analytics.



## RESULTS

If a rainy weather is predicted, then water will not be irrigated to the crops. If the crop is analyzed that it needs to be watered, then the automatic irrigation system will be turned on, and this irrigation notification will be sent to the farmer. Moreover, the farmer will receive an email with general information of crops once a day. The farmer will be able to check the status quo of the crops at any time of their convenience, through simply viewing it on the dashboard. This device accomplished a water saving rate up to 40% in comparison to the traditional agriculture approach.

## RESOURCES NEEDED FOR SCALE-UPS

- Functional upgrades for the device
- Industrial-grade IoT sensors
- Tailored PCB boards
- Additional capital, expertise, and clients

## LEARN MORE

[https://www.hackster.io/Edoliver/agrolora-1c5452?auth\\_token=779fd691e5f7ff22883255985e69a1b](https://www.hackster.io/Edoliver/agrolora-1c5452?auth_token=779fd691e5f7ff22883255985e69a1b)

## CONTRIBUTE

[Luis Eduardo Arevalo Oliver \(samurangedd@gmail.com\)](mailto:samurangedd@gmail.com)

[Victor Altamirano](#)



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

Project Makers: **Kutluhan Aktar**

Sustainability Topic: **Environmental Habitat Monitoring**



*“Since trees are crucial for pollination, spreading tree diseases can cause crop yield loss, animal deaths, widespread infectious epidemics, and even land degradation due to soil erosion. Therefore, it is important to detect tree diseases before they permeate into the forests. ... It is also important to check ... environmental factors to achieve better detection results.”*

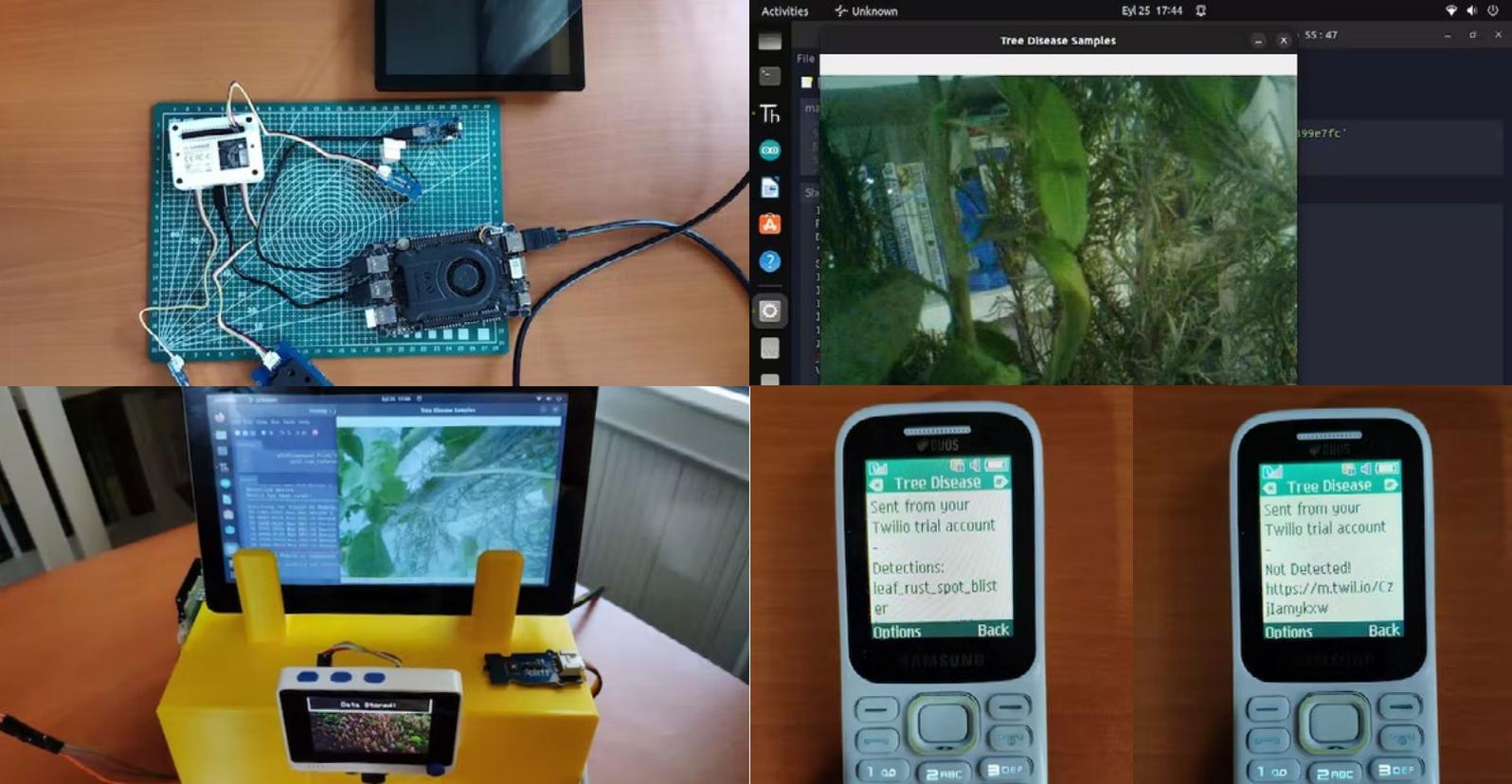
— Kutluhan Aktar

## CHALLENGE

Due to excessive deforestation coupled with climate crisis, trees and plants are increasingly becoming more susceptible to contagious diseases as time goes by. Most tree diseases are found to be fungal, that are caused by droughts, high CO<sub>2</sub> level, overcrowding, and damage to stems or roots. What’s more, tree diseases can be disseminated swiftly over long distances with high expansion rates. Since trees are crucial for pollination, spreading tree diseases can cause crop yield loss, animal deaths, widespread infectious epidemics, and even land degradation due to soil erosion. However, if there are early warnings on potential tree diseases and various environmental factors, it will be possible to take preventative measures with informed decisions, so as to avoid hazardous outcomes and minimize various risks and damages.

## METHODS

On this backdrop, the maker decided to create a low-cost, and easy-to-use device to detect tree diseases with an AI-enabled object detection model, in the hope of providing an advanced and accessible monitoring solution to prevent contagious tree diseases. The device is built on the basis of [SenseCAP K1100 Kit’s](#) Wio Terminal, Grove – AI Vision Module, and Grove – CO<sub>2</sub> & Temperature & Humidity Sensor, that together collect environmental data from trees infected with different types of plant diseases. Then, Edge Impulse’s Faster Objects, More Objects (FOMO) algorithm is harnessed to train object detection models with Machine Learning (ML).



## RESULTS

One can finally receive detection results and early warning notifications through MMS. By applying object detection models trained on captured infected tree images to detect potential tree diseases, the device can be used to: i) avoid crop yield loss, animal deaths, widespread infectious epidemics; ii) prevent land degradation due to soil erosion; iii) mitigate deforestation; and iv) protect wildlife through safeguarding their living habitats.

## LEARN MORE

[https://www.hackster.io/kutluhan-aktar/iot-ai-driven-tree-disease-identifier-w-edge-impulse-mms-1b5ff6?auth\\_token=39801c7687555900b1c3c87255adb10a](https://www.hackster.io/kutluhan-aktar/iot-ai-driven-tree-disease-identifier-w-edge-impulse-mms-1b5ff6?auth_token=39801c7687555900b1c3c87255adb10a)

## CONTRIBUTE

[Kutluhan Aktar \(kutluhanaktar@gmail.com\)](mailto:kutluhanaktar@gmail.com)

Innovative and  
Creative Project Award

seed studio

# Weather Balloon “Mining” Using Blockchain and IoT

Project Makers: **Nicolas Lopez**

Sustainability Topic: **Meteorological Monitoring**



*“For two years I worked at NASA Goddard Space Flight Center on the Geostationary Operational Environmental Satellites-16 (GOES-16) weather satellite, and then left NASA in 2019 to explore blockchain and IoT technologies independently. I immediately recognized the low-power, long-range potential of LoRaWAN to solve one of the most intractable field efforts in the climate science community. ... LoRaWAN ... performs best in line-of-sight situations. It is very suitable for outdoor sensors and indoor monitors that only require sending small amounts of data at a time.”*

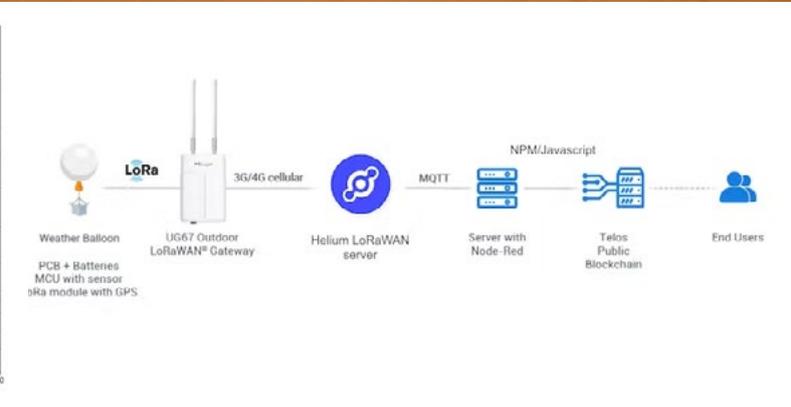
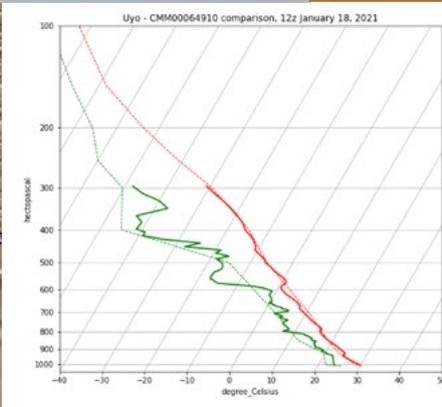
— Nicolas Lopez

## CHALLENGE

Monitoring upper-level-atmospheric data in the Western and Central Africa can play a significant role in weather and climate forecasting. It can help local people to make better, informed decisions and predictions about extreme natural disasters, such as floods, droughts, heavy rainfalls, and can even be used to improve the forecasting of Atlantic hurricanes in the 7 to 14 day timeframe.

## METHODS

This project aimed to measure meteorological data 32,000 feet above Western Africa’s sky, using Grove sensors (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. To make the weather balloon float, the maker and local university students developed a method of inflating the balloons with locally-produced, inexpensive hydrogen – instead of the expensive helium.



## RESULTS

Once the atmospheric pressure is a few millibars lower than the ground pressure, the device recognizes that the balloon has been launched, so it will be transformed into the “flight” mode. Every 5 seconds, it transmits temperature, pressure, and humidity back to the ground receiver. This demonstrates higher resolution data than the current, traditional, government-run meteorological stations. It was found that the data gathered in Uyo city in Nigeria matched well with official weather radiosonde data, which was launched 200 km to the southeast in Douala city in Cameroon. To date, the maker completed 25 launches of weather balloons with university students from five locations in Africa and the USA.

## RESOURCES NEEDED FOR SCALE-UPS

- Custom PCB hardware with NEO-6M GPS and weather sensors
- More university partnerships
- Legal LoRa frequency for some countries in West Africa
- Funding of \$50K to complete 9-months-pilot at University of Douala

## LEARN MORE

[https://www.hackster.io/nicolas-lopez/weather-balloon-mining-using-blockchain-and-iot-94e0e1?auth\\_token=74dbe7a927d091ced88e6e8a0844e889](https://www.hackster.io/nicolas-lopez/weather-balloon-mining-using-blockchain-and-iot-94e0e1?auth_token=74dbe7a927d091ced88e6e8a0844e889)

## CONTRIBUTE

Nicolas Lopez (kandaweather@gmail.com)



Innovative and Creative Project Award

seed studio

# Study of Animal Movement: Equipment Design and Development

Project Makers: Laila Kazimierski, Alejandro Kolton, Erika Kubisch, Karina Laneri, Maru Echave, Nicolas Catalano, David Fernando Cordova Mora, Andres Oliva, Guillermo Abramson  
Sustainability Topic: Wildlife Conservation



*“We are a group ... of biologists, physicists and engineers. We have been working interdisciplinarily for five years with different animal species, different habitats and challenges. We carry out our research at the Bariloche Atomic Center, San Carlos de Bariloche, Río Negro, Argentina. ... Now, with SenseCAP K1100 [Kit], we could put together a connected network of devices that simultaneously monitor animals. ... Knowing how animals move, surveying their trajectories, finding their nests, studying how their behavior depends on external variables are key to establishing guidelines that help their conservation.”*

— Laila Kazimierski et al.

## CHALLENGE

When it comes to the existing wildlife conservation landscape, there are many on-site challenges in measuring the exact accuracy, degrees, and speed of the extinction of endangered species, natural habitat loss, wildlife poaching, and climate change. Indeed, the current status quo of wildlife monitoring techniques and environmental surveillance remain highly traditional and labor-intensive to date. However, with the ongoing development of AI and IoT technologies, conservation efforts can be more efficient, more thorough, and less expensive.

## METHODS

This project aims to answer multifold questions about the basic biology of endangered wildlife species, in this case, a tortoise – *Chelonoidis chilensis* – that is marked as one of the vulnerable animals according to IUCN. Thereby, by using Wio Terminal and Grove – Long Range 868 MHz together with Arduino IDE, the makers were able to design and develop a prototype device that can be effectively used for mapping out and monitoring the animal’s movement patterns, trajectories, nests, and natural environmental habitats in real-time.

## RESULTS

The prototype device demonstrated numerous possibilities of monitoring animal movement



and behavior patterns that will be helpful in determining their activities based on different environmental variables, including the time of the day, weather conditions, and temperature and wind changes. Using the animal movement data, a neural network was trained to be capable of distinguishing movement from stillness, as well as different animal activities: moving, eating, copulating, digging nests to lay eggs, etc. Through this project, the makers re-learned the significance of LoRaWAN in scaling up this prototype for scientific purposes, while praising its long-range and low-power characteristics. Currently, the project's challenge is focused on upgrading the prototype device for a diversity of species and contexts tailored to various field needs, as well as to miniaturize the device size. Potentially, the upgraded device can not only contribute to understanding the basic biology of this species at an in-depth level, but also to help establish concrete guidelines for their conservation.

### RESOURCES NEEDED FOR SCALE-UPS

- [SenseCAP LoRaWAN Outdoor Gateway](#) for gathering animal tracking data
- [SenseCAP sensors](#) for weather monitoring
- [Grove – Wio-E5](#) modules to monitor individuals
- Miniaturization of tracking device to allow the monitoring of smaller species
- Devices that have the greatest autonomy like using solar panels for the tracking device
- Protective cases designed for each species

### LEARN MORE

<https://www.hackster.io/471203/study-of-animal-movement-equipment-design-and-development-febb17>

### CONTRIBUTE

Laila Kazimierski (lailakazimierski@gmail.com)



# MonSand: Monitoring Illegal Sand Mining

Project Makers: **Raunak Singh**  
Sustainability Topic: **Sand Mining**



*“Sand is used in numerous applications such as construction (for cement), and microchips (for silicon). But the problem is that as the uses of this material are increasing, the supply is greatly decreasing. ... Normal desert sand is smooth and round and doesn’t bind together. This means that it can’t be utilized in the production of glass used in the windshield of cars or the screens of our phones. Instead, we have to use river sand (wet sand) which is angular and easily sticks together. We are running out of ways to legally mine wet sand without disturbing the coastline. So, in many Third World countries, sand is being supplied to industry through illegal ways that are harmful to the environment.”*

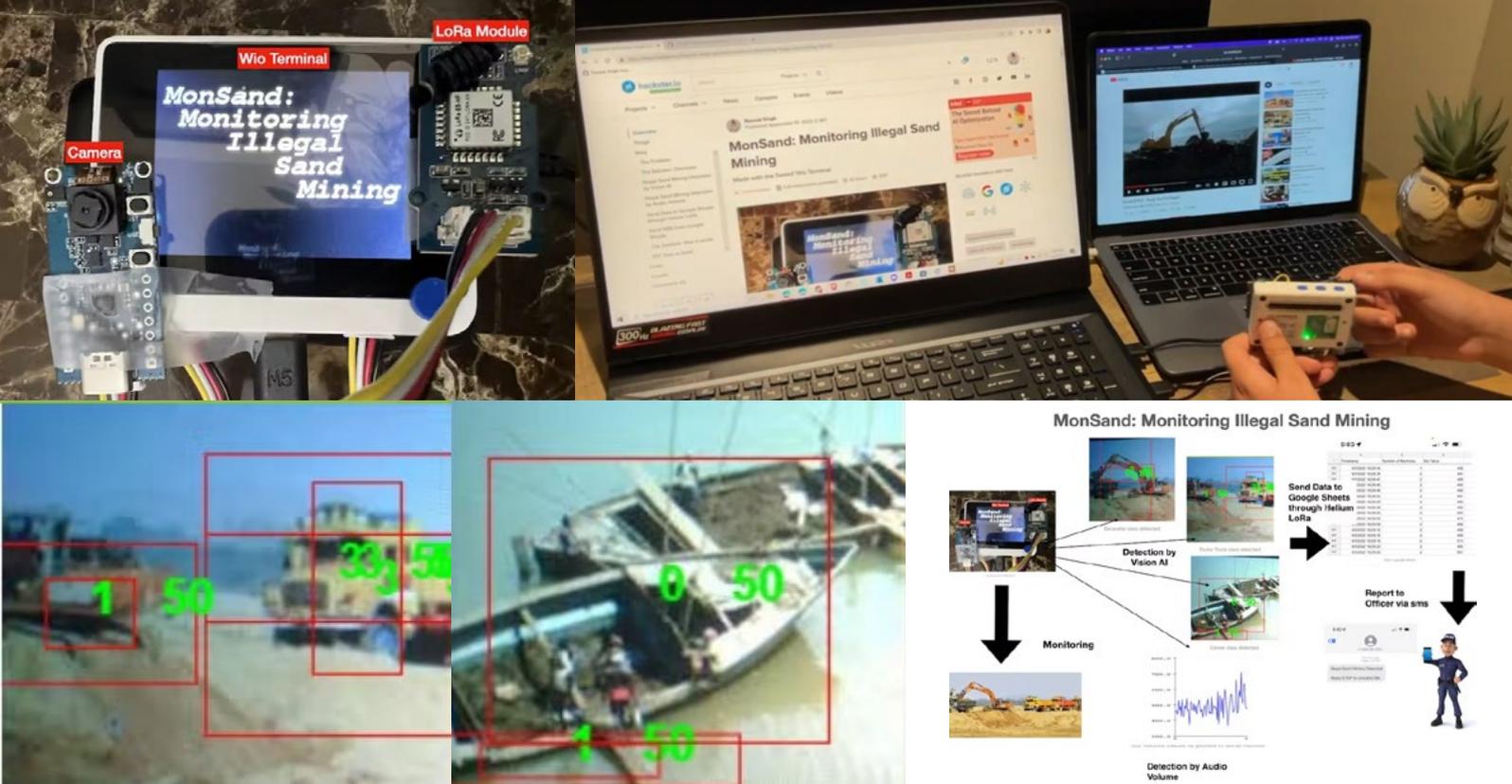
— Raunak Singh

## CHALLENGE

Marine sand is the most extracted “solid” material on Earth, and 50 billion tons of marine sand is used every year worldwide. Its usage is deeply ingrained in humanity’s everyday life, ranging from making building materials for infrastructure projects, developing diverse commodities to be consumed everyday, to maintaining livelihoods and marine ecosystems. ([UNEP, 2022](#)). As it is the case with other mineral resources, marine sand is notorious for being illegally extracted from seabeds, riverbeds, lakes, and deltas, that affect the lives of people and wildlife living nearby.

## METHODS

The project is about monitoring and detecting illegal sand mining activities at various water bodies, especially in the oceans and river banks. By using [Wio Terminal](#), [SenseCAP K1100 Kit](#), and [Grove Lora E5](#), ‘MonSand’ device is able to capture the environmental and surrounding data of illegal sand mining sites, after which the collected data is sent to [Helium Console](#), and then analyzed monitoring outcomes will be directly shown on [Google Sheets](#).



## RESULTS

When certain illegal activities are detected, SMS will be sent to relevant authorities, either government agencies or NGOs, to go to the sand mining sites in concern and tackle the problems on-site, in real-time. The maker's YOLOv5 model has 68.4% mean average precision (mAP) accuracy in detecting different types of illegal activities. It has 72.2% recall (100% means no false negatives) and 66.5% precision (100% means no false positives). The model has good accuracy for Tiny Machine Learning (tinyML) as its accuracy is constrained by model memory size limits.

## RESOURCES NEEDED FOR SCALE-UPS

- 3D print the enclosure case to make the prototype device weather-proof
- GPS sensor for location tracking

## LEARN MORE

<https://www.hackster.io/Raunak-Singh-Inventor/monsand-monitoring-illegal-sand-mining-561307>

## CONTRIBUTE

Raunak Singh (raunak.singh.inventor@gmail.com)



# Wildlife Sanctuary Monitor

Project Makers: **Hendra Kusumah**  
Sustainability Topic: **Wildlife Conservation**



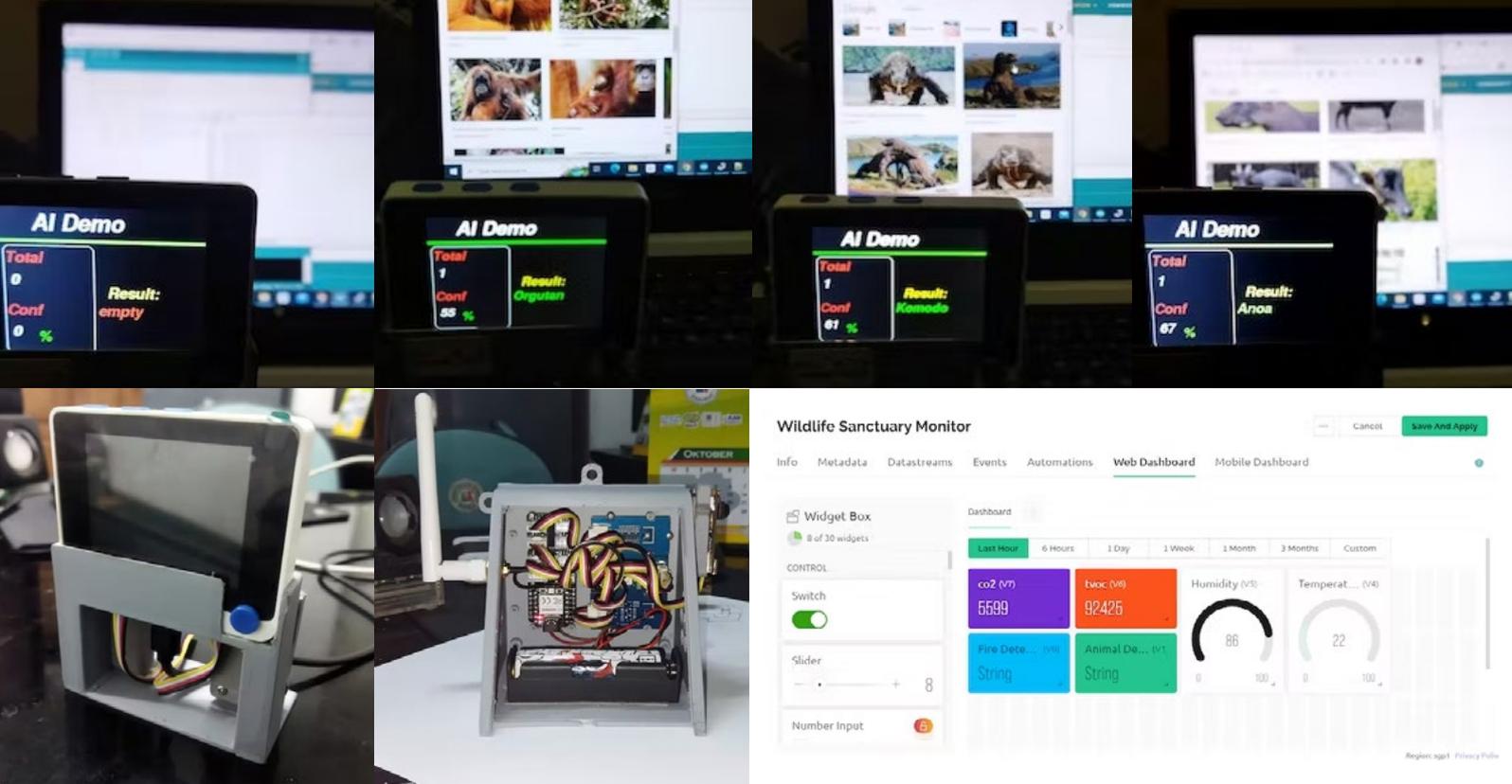
## CHALLENGE

*“Indonesia is home to the third-largest tropical forest after the Amazon and Congo. Some of these forests have biodiversity values and are also used as a sanctuary to protect rare animals that are endemic in Indonesia. ... Conservation doesn’t run well in the forests of Indonesia due to various things. ... Javan Rhinoceros is one of the animals that are still concerned to become extinct and still preserved until this day in Ujung Kulon National Park sanctuary. The Javan Rhinoceros is different from other rhinoceros because they only have one horn, and the horn is believed to have medicinal content. Because of that reason, there are still some people who do illegal hunting. ... Another animal that is constantly hunted is the orangutan. According to various article sources, more than 100,000 orangutans have been killed in the past 20 years due to illegal trading and deforestation. ... The main challenge in conservation according to the article is lack of staff or resources to protect the forests: only 1 staff is responsible for 7,000 acres of forest. Another challenge for conservation is wildfire. ... I want to build a device that helps conservation to monitor the forests’ conditions and detect the endangered animals.”*

— Hendra Kusumah

## METHODS

This project focused on harnessing audio classification to check the endangered wildlife’s liveliness, using object detection to check the wildlife activities, notifying illegal poaching activities in real-time, and triggering early warnings on wildfire detection to prevent the spread of wildfires.



## RESULTS

Through embedding SenseCAP K1100 Kit, Seeed Studio XIAO RP2040, and Edge Impulse, the prototype device achieved long-distance, wireless transmissions of data outcomes to appear on computer dashboards and smartphone messages.

## RESOURCES NEEDED FOR SCALE-UPS

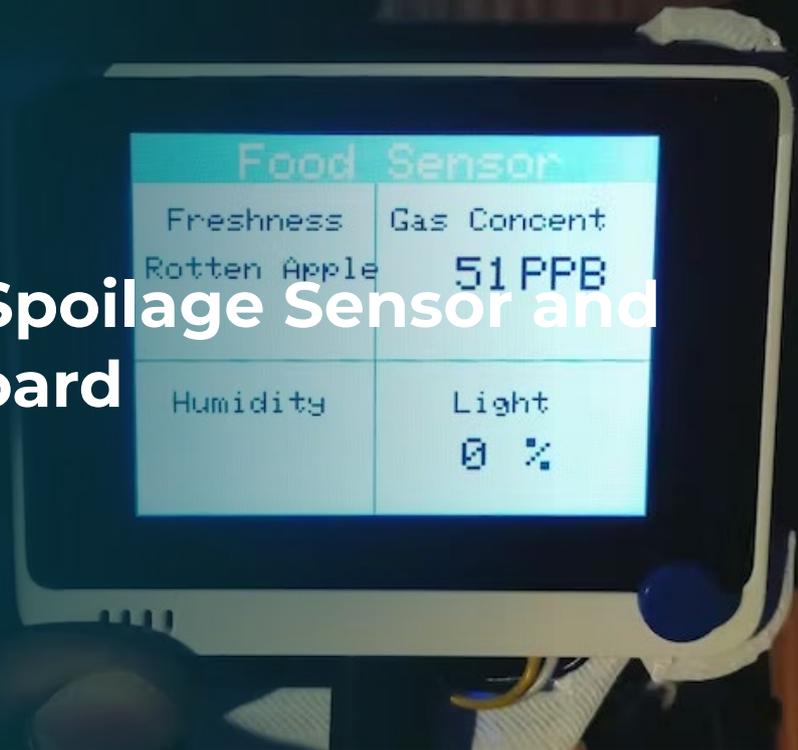
- Industrial-grade SenseCAP sensors
- Multi-stakeholder partnerships with NGOs and government authorities

## LEARN MORE

<https://www.hackster.io/hendra/wildlife-sanctuary-monitor-4162ec>

## CONTRIBUTE

Hendra Kusumah (h.kusumah87@gmail.com)



# DeViridi: IoT Food Spoilage Sensor and Monitoring Dashboard

Project Makers: Ashwin Sridhar  
Sustainability Topic: Food Spoilage



## CHALLENGE

“Food waste across the agriculture sector is an increasingly growing contributor to greenhouse emissions. ... Food waste occurs due to pests and storage conditions, with many farmers, storage houses, and exporters throwing away the yields due to food appearance and fear of spoilage. Current methods of determining spoilage remain qualitative, but the detection of released gasses and Computer Vision provides a more effective solution. A low-cost solution is required, which not only improves food preservation but can also detect food spoilage to assure food quality.”

— Ashwin Sridhar

## METHODS

The project is about developing a smart, IoT-powered device, which can be used to monitor food storage conditions and determine food spoilage at an early stage. The device is based on AI image detection models coupled with multi-gas identification, using [SenseCAP K1100 Kit](#), [Wio Terminal](#), [Grove — AI Vision Sensor](#), and [TensorFlow](#).

## RESULTS

Different types of food will emit various types of gas based on their core composition elements. For example, rotting meat products will release ammonia (NH<sub>3</sub>) and hydrogen sulfide (H<sub>2</sub>S), whereas fruits and vegetables will produce ethylene (C<sub>2</sub>H<sub>4</sub>). Therefore, detection of the gas composition of the surrounding air quality can help farmers, suppliers, supermarkets, and households to more accurately determine the progress and extent of food rotting procedure, not to mention edibility of food.

rotten

SEARCH BY:

Subject

Metadata



**Tomato**

by **Raher**  
 RIPE-TOMATOES  
 760 IMAGES

Object Detection



**knowledge-distillation**

by **Brac University**  
 FOL  
 1878 IMAGES

Classification

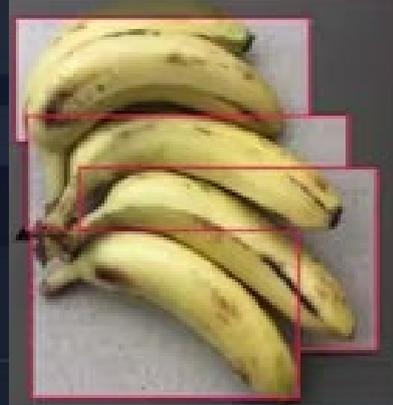


**Defected Tomatoes**

by **POOSys**  
 TOMATOES  
 37 IMAGES

Object Detection

Model



**Fruit Freshness Detection**

Object Detection

Overview

Images

5178

Dataset

7

Model

**LEARN MORE**

[https://www.hackster.io/cyborgash122/deviridi-iot-food-spoilage-sensor-and-monitoring-dashboard-e2f933?auth\\_token=e7a6264d9624a9b096a3e52cd376afff](https://www.hackster.io/cyborgash122/deviridi-iot-food-spoilage-sensor-and-monitoring-dashboard-e2f933?auth_token=e7a6264d9624a9b096a3e52cd376afff)

**CONTRIBUTE**

Ashwin Sridhar



# Smart UV Meter

Project Makers: **Thorsten**

Sustainability Topic: **UV Radiation Exposure**



## CHALLENGE

*“UV-related diseases, especially skin cancer, are causing problems on public well-being around the world, as well as resulting in high and increasing healthcare costs. Ozone depletion and climate change are aggravating this situation.”*

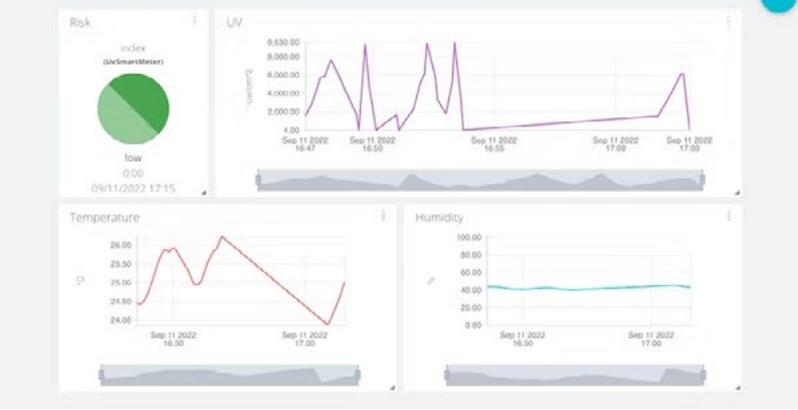
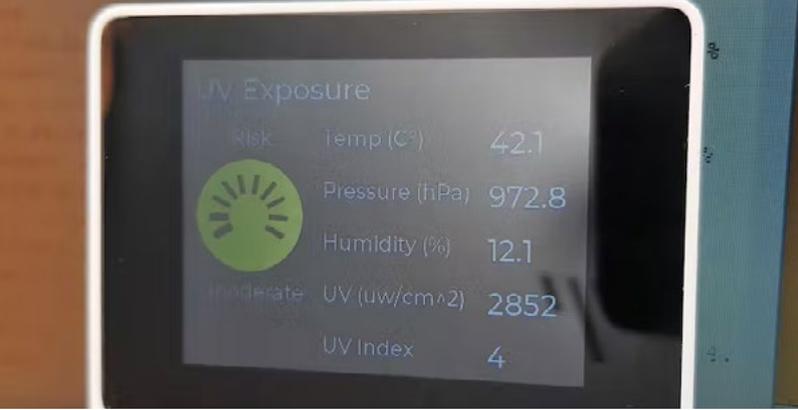
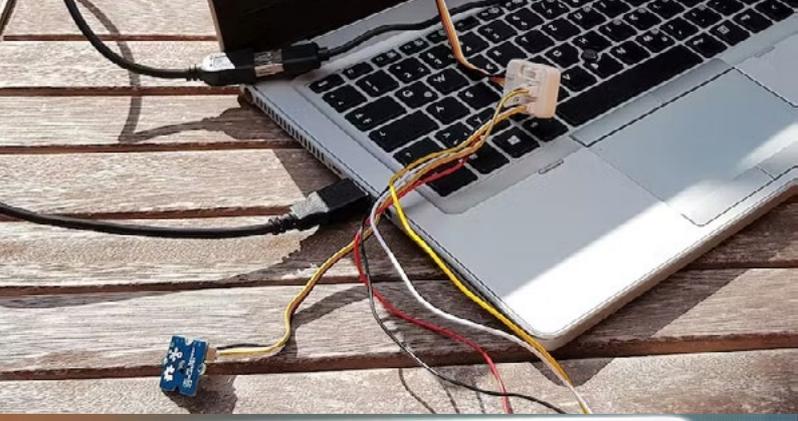
— Thorsten

## METHODS

The maker implemented an UV radiation exposure monitoring device to help prevent possible skin diseases through sending out preventative warning messages according to the detected UV exposure levels. By using [Wio Terminal](#), [Grove — Wio-E5](#), [Grove — I2C Hub](#), [Grove — I2C UV light Sensor](#), [Helium Console](#), and [Ubidots](#), it functions as a remote sensor unit, as well as a personal dosimeter to continuously measure the UV index and other environmental parameters (air humidity and temperature) to observe enhanced level of harmful effects from certain UV radiation levels. Moreover, the device can calculate individual risks in a specifically monitored area.

## RESULTS

As a result, collected environmental data will be uploaded on Ubidots (an IoT cloud platform) via Wifi or LoRaWan for aggregation and visualization. The data can be used to tailor warning messages for preventive actions, including but not limited to applying sunscreen, wearing protective clothes, and limiting sun exposure time.



### RESOURCES NEEDED FOR SCALE-UPS

- Device firmware enhancement (robustness, usability, service onboarding)
- Industrial-grade SenseCAP sensors for outdoors
- Rugged enclosure
- Robust IoT service infrastructures for data collection, aggregation and visualization

### LEARN MORE

<https://www.hackster.io/dxcfl/smart-uv-meter-ultraviolet-radiation-exposure-monitoring-4b5937>

### CONTRIBUTE

Thorsten (dxc.flicktho@gmail.com)



# Black Soldier Fly Farming – Creating Protein Content

Project Makers: Team Tanzania Open Innovation (Shaukatali Hussein, Sahil Abdulalim)  
Sustainability Topic: Precision Agriculture



## CHALLENGE

“Animal feeds currently fed to chickens, pigs and farmed fish, all require high levels of protein. At the moment, that protein comes from soy or fish meal. The inputs to produce both of these protein sources are made by consuming natural resources, which are being consumed at an unsustainable rate. ... Black soldier fly (BSF) is an insect native to Africa, and as a larvae, it can consume as much as 70% of its own body weight in waste every day. For every kilogram of organic waste it consumes, 50 grams of protein can be produced. We use the larvae of this fly to recycle nutrients in food waste and make the protein content for chicken or fish feed.”

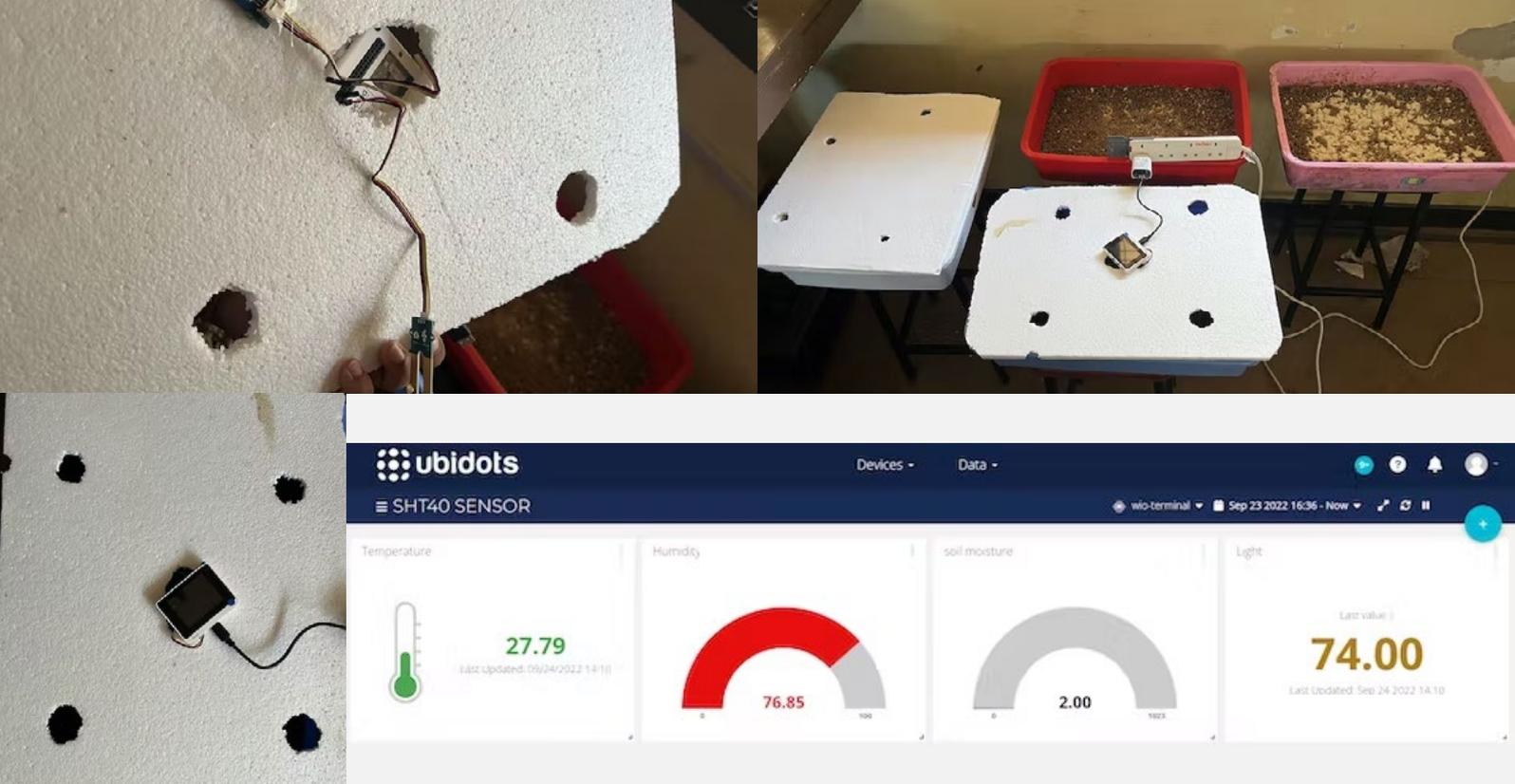
– Team Tanzania Open Innovation

## METHODS

The project sheds light on cultivating smart BSF farming as an alternative, sustainable, and accessible protein content production method to complement animal feed. Using the SenseCAP K1100 Kit, the main environmental parameters that are monitored in real-time include air temperature and humidity, soil moisture and temperature, as well as light intensity.

## RESULTS

After monitoring the environmental surroundings of a mini BSF farm indoors for 3–4 days, BSF larvae have begun to be hatched successfully within the suitable hatching environment. Considering the potential of widespread BSF farming in Africa to replace 60 million tons of traditional feed production and fertilizers, it is estimated that 15 million jobs can be created, 86 million tons of CO<sub>2</sub> emissions can be prevented, and a market value of crude protein can be increased up to US\$ 2.6 billion.



### RESOURCES NEEDED FOR SCALE-UPS

- SenseCAP A1101 – LoRaWAN Vision AI Sensor to monitor larvae behaviors based on atmospheric conditions
- Industrial-grade SenseCAP sensors for the project scale-up to monitor BSF farm's weather conditions and ensure maximum egg production rates within the optimal conditions

### LEARN MORE

<https://www.hackster.io/tanzania-open-innovation/black-soldier-fly-farming-creating-protein-content-b9e72c>

### CONTRIBUTE

Shaukatali Hussein (shaukat@robotech.co.tz)



# Monitoring Health of a Wind Turbine in 3D

Project Makers: **Laziz Turakulov**

Sustainability Topic: **Wind Energy Management**



## CHALLENGE

*“Wind farms are great contributors to our sustainability agenda as generators of green renewable energy. They are typically located in some remote onshore/offshore locations, which makes it crucial to monitor their health and provide timely support.”*

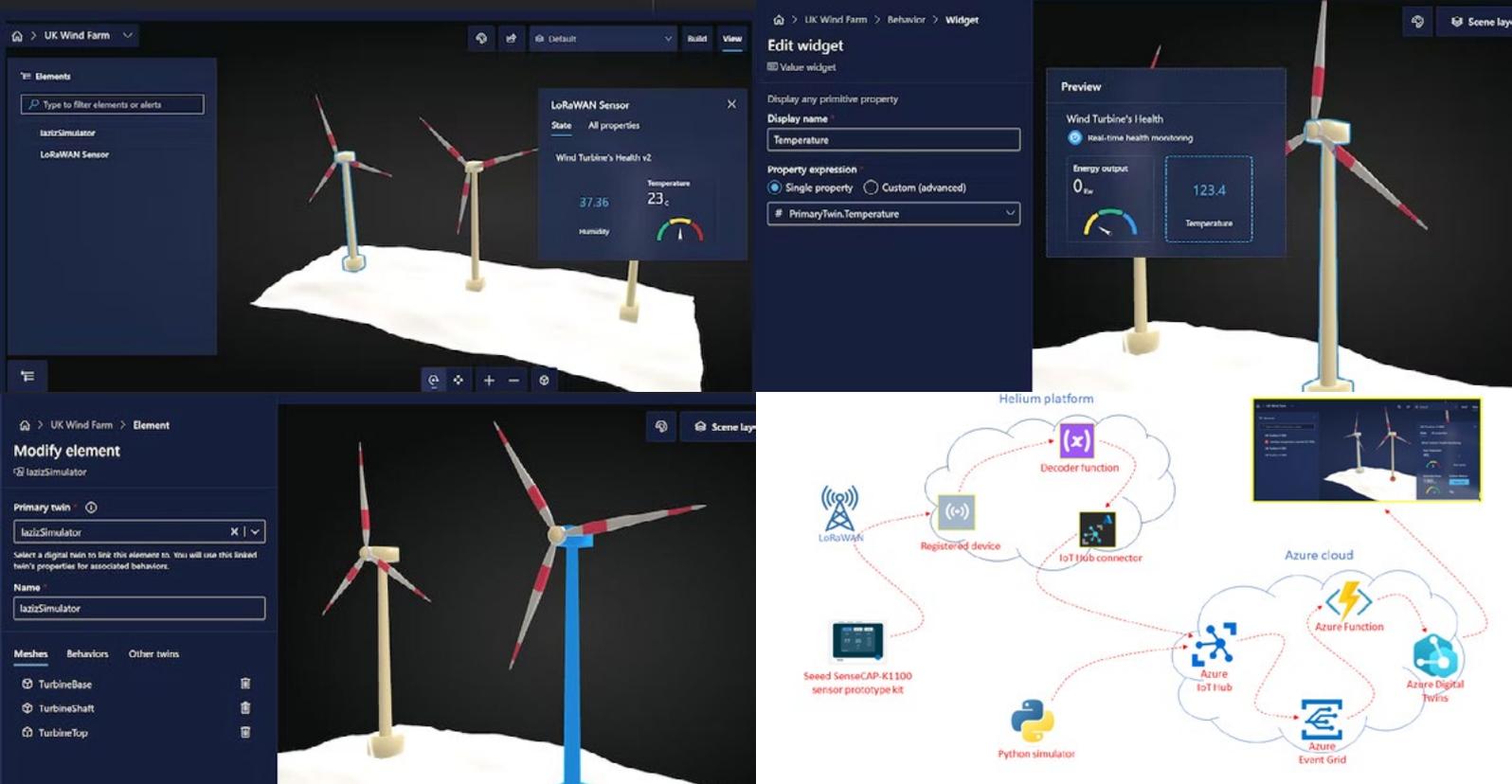
— Laziz Turakulov

## METHODS

This project emphasized the importance of monitoring the health of wind turbines in remote locations, so as to detect optimal maintenance period by using [Wio Terminal](#), [SenseCAP K1100 Kit's](#) environmental sensors, and [Helium Console](#). The sensors are connected with LoRaWAN network for data transfers, and [Microsoft Azure](#) analyzes and visualizes the data findings on computers.

## RESULTS

With this project prototype, one can monitor the end-to-end connectivity between physical wind turbines and their 3D digital twin. Streamed telemetry (turbine's gear temperature, energy output, wind speed and other environmental readings) can help to determine the health of the wind turbine. Helium payload is compact enough to meet my backend's limit of 32 Kb. Additionally, the backend itself supports up to 2 Mln digital twin instances, which is enough to cover the fleet of several green energy service providers. Real-time monitoring of remote wind farms can transform maintenance process from reactive to proactive. This in turn, as per [the findings from the US Department of Energy](#), can reduce maintenance costs up to 30%, eliminate breakdowns up to 75% and increase productivity of equipment up to 25%.



## RESOURCES NEEDED FOR SCALE-UPS

- Industrial-grade SenseCAP sensors
- Pilot project with selected customers to test and receive feedback on telemetry inputs, required Key Performance Indicators (KPIs), and data visualizations

## LEARN MORE

<https://www.hackster.io/user87111/monitoring-health-of-a-wind-turbine-in-3d-digital-twin-d822ce>

## CONTRIBUTE

Laziz Turakulov (lazizturakulov2013@gmail.com)



# Penguin Counting and Monitoring

Project Makers: **Richard Wright**

Sustainability Topic: **Wildlife Conservation**



## CHALLENGE

*“Discarded nets, marine plastic pollution. Sea temperature rise, marine heatwaves. Coastal erosion and inundation destroy nesting habitat. Predation by feral cats, dogs, mustelids and rats. Things are pretty dire for the Little Blue Penguin (kororā in Maori). ... New Zealand’s Department of Conservation categorizes kororā as ‘declining/at risk’. ... which is present throughout New Zealand and in the south and south east of Australia.”*

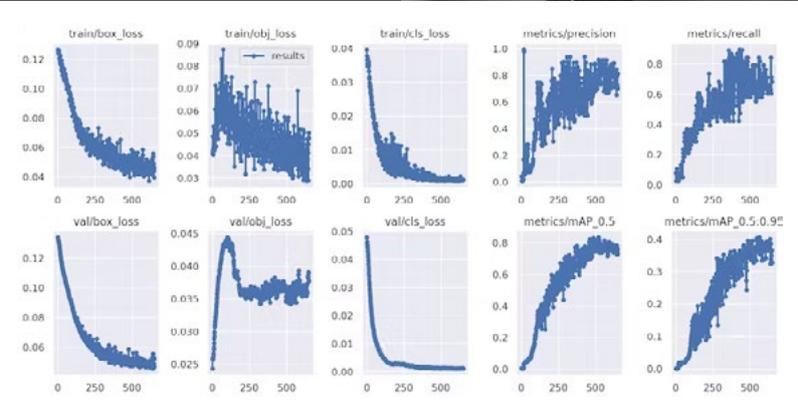
— Richard Wright

## METHODS

This project is concentrated on building an AI object detection system to identify, count, monitor, and protect the Little Blue Penguins when they come ashore and go to the sea, through harnessing LoRaWAN network, [Wio Terminal](#), and [Grove AI Vision Sensor](#), to monitor the endangered species in both real-time, and chronological manner.

## RESULTS

Potentially, a series of low-cost cameras with long battery life can detect predator animals, help alert penguin protection groups to take necessary actions in preventing wildlife-human conflicts, as well as provide education to local communities about their presence and the need to protect them. Last but not least, monitoring the penguins’ quantity ashore at a longer term and over a greater geographic area could contribute to the wildlife population studies, as an effort to facilitate improvements in the protection of such species.

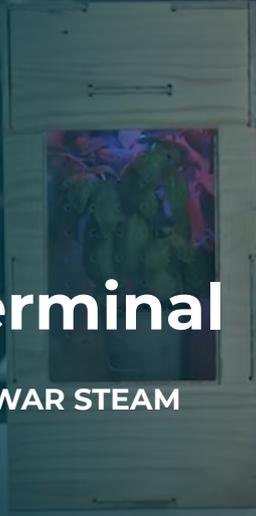


**LEARN MORE**

[https://www.hackster.io/mediapod/penguin-counting-and-monitoring-2bdc1c?auth\\_token=f2bfe1f000f8bac86287434e35d2b4b](https://www.hackster.io/mediapod/penguin-counting-and-monitoring-2bdc1c?auth_token=f2bfe1f000f8bac86287434e35d2b4b)

**CONTRIBUTE**

Richard Wright



# POWAR v2.0 - WIO Terminal

Project Makers: **Pablo Zuloaga Betancourt - POWAR STEAM**  
Sustainability Topic: **Climate-Smart Agriculture**

- |                 |                   |
|-----------------|-------------------|
| <b>SENSORS:</b> | <b>ACTUATORS:</b> |
| - DHT11         | - Water Pump      |
| - LDR           | - Grow Lights     |
| - Soil Moisture | - Ventilator      |
| - Water Level   | - LCD Screen      |
| - pH            | - Heating Lamp    |
| - Gas           | - Cooling System  |



## CHALLENGE

*“Climate change-related crises, such as floods or drought, affect the lives and livelihoods of millions of people, exacerbating poverty, hunger and social tensions. POWAR helps communities and governments understand these growing risks and take specific action to manage the impact of climate crises on food security.”*

— Pablo Zuloaga Betancourt

## METHODS

POWAR, the Plant Observatory of Weather Adaptability for Resilience, is a DIY, low-cost, climate simulator for research and education about the effects of future weathers in the food we grow nowadays. Based on Wio Terminal and SenseCAP K1100 Kit, POWAR seeks to empower smallholder farmers on how climate change may affect what they grow today, and facilitate them to become more resilient farmers to future weather patterns.

## RESULTS

The more people use POWAR in different parts of the world, the more experiments there will be on different crops and climates. Thereby, an open knowledge database could be created to feed an AI model to draw predictions about the best ways to grow different types of food produced in extreme weathers.



### RESOURCES NEEDED FOR SCALE-UPS

- Design and produce a shield to reduce connections between the Wio Terminal, the groove sensors, and the actuators, which can also convert the power supply into multiple output voltages (5v–12v)
- Evolve the Node-Red control interface to a Blink premium account to be able to add and control more devices independently
- Find a more effective way to produce temperature (heat and cold)
- Convert the code into firmware so that it is easily installable on the Wio Terminal or a MicroSD

### LEARN MORE

<https://www.hackster.io/pabzul/powar-v2-0-wio-terminal-73f2b9>

### CONTRIBUTE

Pablo Zuloaga Betancourt (pabzul@gmail.com)



# Wireless Monitoring System for GHGs Emissions in Paddy Field

Project Makers: **JAMES Lam**

Sustainability Topic: **Greenhouse Gas (GHG)**



## CHALLENGE

*"Paddy field is one of the major sources of greenhouse gasses (both methane and nitrogen oxides) according to some research, however, some recent research suggests that there are miscalculations. To find out, I built an easily deployed methane monitor to help rice farmers or other interested citizen scientists to look into this issue. Because rice is the main source of food for most Asian countries, it is important that we acknowledge the problem accurately and respond accordingly."*

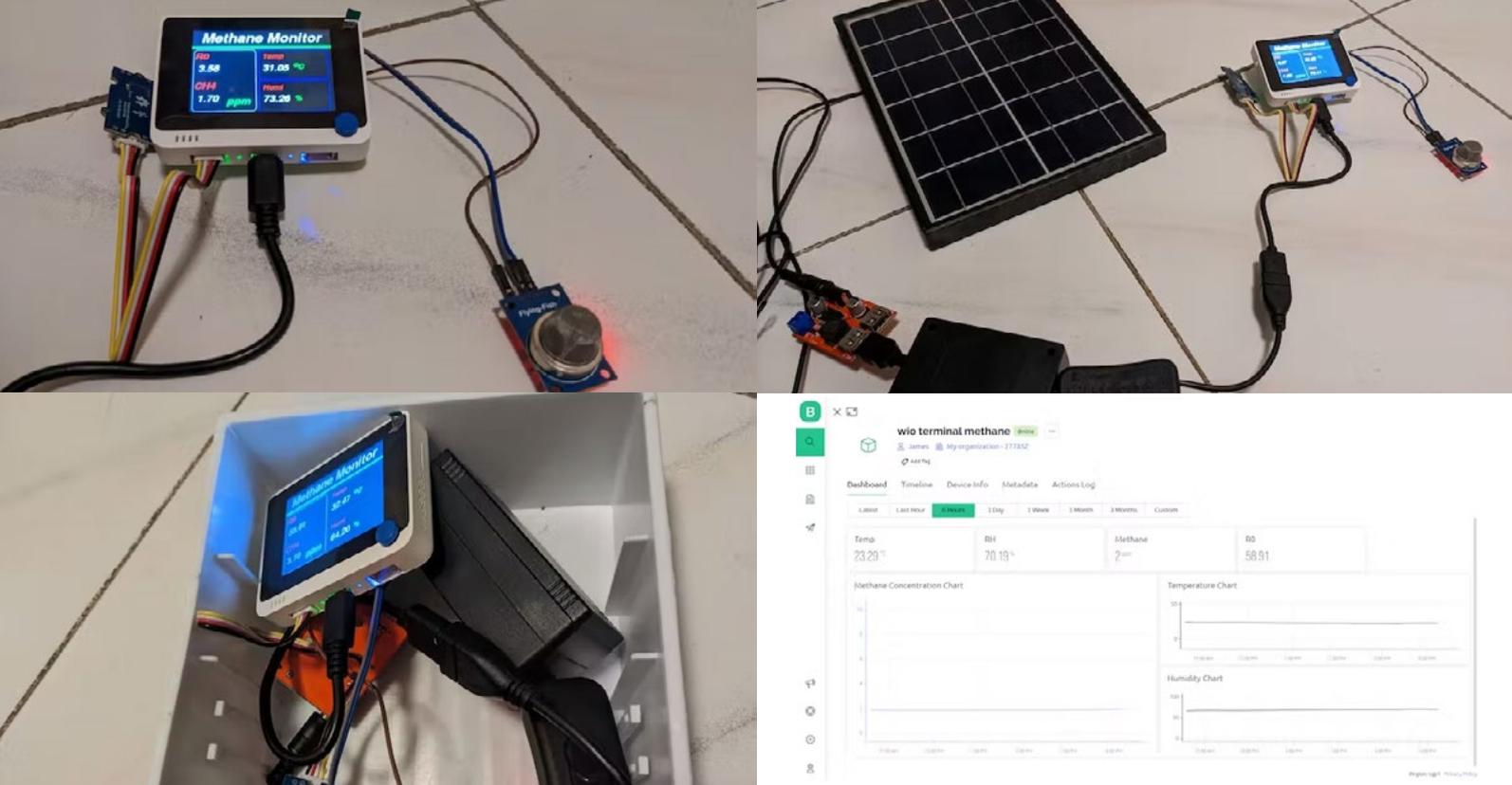
— JAMES Lam

## METHODS

The project prototype serves as an entry-level kit for interested farmers and citizen scientists to start monitoring the concentration of methane in their surrounding environment, and collect and analyze the data to study different environmental parameters on the emission of GHG. The project employed [Wio Terminal](#), [Grove – I2C High Accuracy Temp&Humi Sensor](#), and [Blynk](#).

## RESULTS

Since it was not the rice-growing season in Hong Kong when the maker was implementing this project, he tested the monitoring system at his office where there is a central air-conditioning system. Regardless, the results were quite good. Despite the varying humidity, the temperature is stable at around 25 degree Celsius, and methane concentration is slightly over 2 ppm. It matches with the global methane concentration of 1.8 ppm, and falls with the 2.2–3.5 ppm range measured in other studies.



### RESOURCES NEEDED FOR SCALE-UPS

- Improvement on the enclosure design for making it waterproof and installing a fan for air ventilation to increase data accuracy
- Verify data accuracy, reliability of electronic components, and enclosure robustness in local farms or urban gardens
- Upgrade Blynk account or switch to another IoT platforms to support more devices

### LEARN MORE

<https://www.hackster.io/james-woods/wireless-monitoring-system-for-ghgs-emissions-in-paddy-field-7d2991>

### CONTRIBUTE

JAmes\_Lam (linxz2008@hotmail.com)



Helium Award



# NOMOS: Mosquito Growth Monitoring System

Project Makers: Rifqi Abdillah  
Sustainability Topic: Health



## CHALLENGE

*“In urban areas, especially in Indonesia, sewer lines are generally located at the front of the house. These sewer lines will drain the remaining water that has been used from each house to a landfill. In some sewer lines, some obstacles cause water to not flow correctly - when coupled with the tropical season in Indonesia, these conditions are an optimal place for mosquitoes to breed. Before this causes a worse impact, some treatments are needed to solve this problem.”*

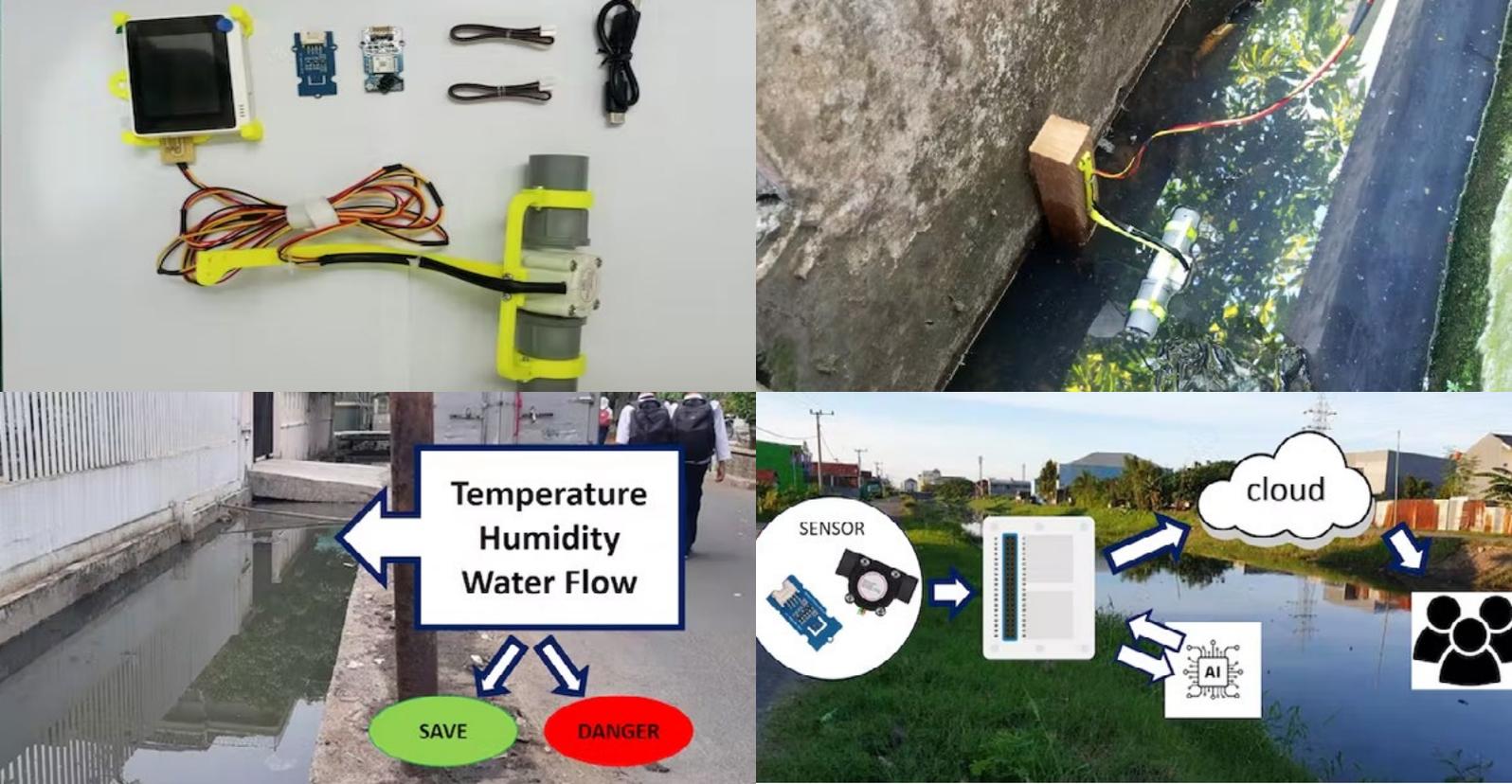
— Rifqi Abdillah

## METHODS

NOMOS — which stands for ‘NO MOSquitoes’ — is a mosquito growth monitoring system based on temperature, humidity, and water flow that can be implemented in local sewage systems to minimize the spread of dengue fever. NOMOS will monitor the water flow to check if the water flow is running normally or not. Warm temperature is one of the indicators that can determine whether the sewer condition is an optimal place for mosquitoes to breed. All data collected from relevant sensors of [SenseCAP K1100 Kit](#) is sent to the database, then the system provides notifications to users. Moreover, [tinyML](#) on the [Edge Impulse](#) platform can be used to predict the level of dangers that may arise.

## RESULTS

NOMOS can be used to monitor sewer conditions to prevent the breeding of mosquitoes in sewers whose conditions do not flow properly, as well as in dry and warm environmental conditions. The maker hopes that NOMOS can become one of the real-world solutions to reduce the risk of mosquito breeding in urban areas by embedding more additional features like monitoring water flows and conditions of sewer cleanliness. The maker described his project with a local proverb in Indonesia: “Provide an umbrella before it rains”, which means that it is better to take preventative measures before bigger challenges occur.



### RESOURCES NEEDED FOR SCALE-UPS

- Industrial-grade components for better prototypes
- Local government support for follow-up handling of hazard conditions
- Team support to create an integrated monitoring system

### LEARN MORE

<https://www.hackster.io/rifqiabdillah/nomos-mosquito-growth-monitoring-system-6def4c>

### CONTRIBUTE

Rifqi Abdullah (rifqi.bring@gmail.com)



TO CHECK PLASTIC BOTTLE DUMPED TO THE LAKE

# Plastic Bottle Detector For Lake

Project Makers: JuanYi

Sustainability Topic: Plastic Pollution



## CHALLENGE

“Many people think plastic bottles/containers are something that will be “digested” by our Mother Nature, and so they just discard them to rivers, drains, lakes, and oceans at their convenience. My project is inspired by the famous cartoon character ‘WALL-E’, which is a robot designed to clean up the trash on Earth. It’s a good movie that highlights how serious it can be if human beings continue dumping trash to Mother Nature. Some day, we will need a WALL-E to clean up our mess.”

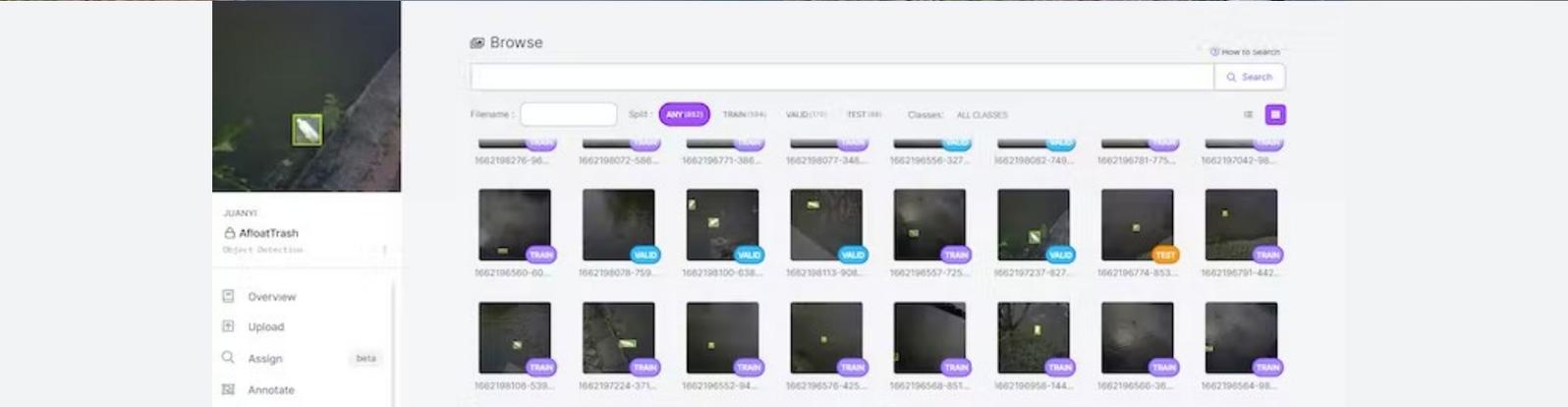
— JuanYi

## METHODS

The project is about using AI Vision to detect plastic bottles floating on lake surfaces and send the collected data to the cloud for easy configuration for real-time and chronological analysis. The project is developed using [SenseCAP K1100 Kit's Wio Terminal](#) – the controller with TFT display; [Grove-Vision AI Sensor](#) – to run inference for object detection, and; [Grove-LoRa E5](#) – to send data by connecting it to Helium.

## RESULTS

As a result, the project prototype was able to identify how many plastic bottles were floating on the water surface. In the future, the project is sought to be upgraded with a mechanism to retrieve the detected plastic bottles and other plastic wastes from the lake.



## LEARN MORE

<https://www.hackster.io/JuanYi/plastic-bottle-detector-for-lake-353996>

## CONTRIBUTE

[JuanYi](#)



# FarmBOX

Project Makers: **Team FarmBOX (Michael Reeves, Richard Fox)**  
Sustainability Topic: **Smart Gardening**



*“FarmBOX empowers students in schools to learn about a whole variety of technologies, including Helium and LoRaWAN. ... Give a man a fish, they will eat for a day. Teach a man to fish, they will eat forever. Give someone an IoT Device, they will use it for a day. Allow someone to extend an IoT Device, it will be forever useful.”*

— Team FarmBOX

## CHALLENGE

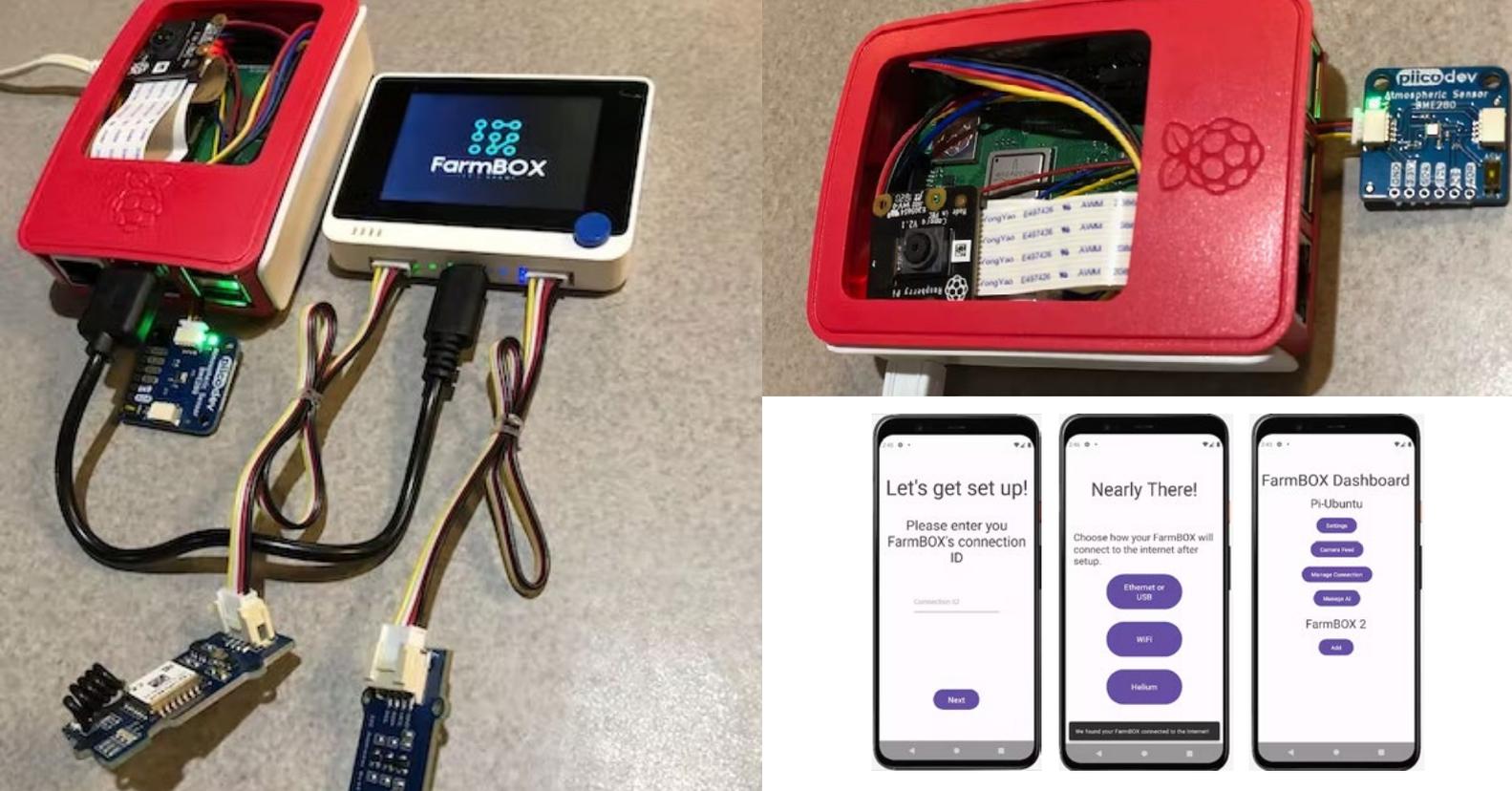
The aim of FarmBOX was to develop a device which takes all the guesswork out of local crop production. It can facilitate self-empowerment of students, individuals and communities to get started with growing their own food, while learning about emerging technologies like AI and IoT. The device is low-cost, and ready for deployment in remote or rural areas.

## METHODS

FarmBOX is an IoT device designed to enable AIoT-powered sustainable monitoring of plant cultivation, built on the basis of [SenseCAP K1100 Kit](#) and [Wio Terminal](#). It can be automatically adjusted to plant and irrigate plants on the basis of various sensor data analyses. For instance, it can irrigate more water in case the soil and air temperature indicates a certain amount of temperature range. Having a [Grove — AI Vision Sensor](#) allows real-time monitoring of plants and crops to minimize the frequency of site visits in-person, monitoring and sending alerts on plant ripeness, status of plant health and diseases, and the like.

## RESULTS

The prototype device has multifold functions, like automatically adjusting plant/crop irrigation periods based on sensor readings, providing additional irrigation if atmospheric temperature surpasses a certain amount of temperature value, while postponing the irrigation if the soil wetness is identified on configurable parameters. Furthermore, with a live camera feed, it is possible to monitor the growth, ripeness, health and disease status of plants/crops anywhere in the world with an Android App – through which general management of plants/crops can be



done, and message alerts and notifications can be triggered.

### RESOURCES NEEDED FOR SCALE-UPS

- Replace the spinning water wheel with a solenoid valve for more precise watering, and less water waste
- Partners who will test and verify the device on the field

### LEARN MORE

[https://www.hackster.io/team-farmbox/farmbox-e8658c?auth\\_token=5f75b8c109897a76df242014444b42a6](https://www.hackster.io/team-farmbox/farmbox-e8658c?auth_token=5f75b8c109897a76df242014444b42a6)

### CONTRIBUTE

Michael Reeves (michael.reeves077@gmail.com)



# Fight Fire – Wild Fire Prediction Using TinyML

Project Makers: **Muhammed Zain, Salman Faris**  
Sustainability Topic: **Wildfire**



## CHALLENGE

*“Wildfires affect all biomes, from forests and savannas to grasslands and tundra. ... In April 2020, the number of fire alerts across the globe was up by 13% compared to the previous year – which was already a record year for fires. Persistent hotter and drier weather due to climate change, and other human factors such as land conversion for agriculture and poor forest management are the main drivers behind the increase. It is estimated that humans are responsible for around 75% of all wildfires.”*

– Muhammed Zain, Salman Faris

## METHODS

Fight Fire is a wildfire prediction device that can help firefighting authorities to respond quickly to the wildfire instantly at an early stage, as well as to identify the presence of humans and wildlife species in the hazardous area of concern. Made on the basis of [Wio Terminal](#), [Grove – Temperature & Humidity Sensor](#), [Grove – LoRa E5](#), [Helium’s LoRaWAN Hospot](#), [Edge Impulse Studio](#), and [Node-RED](#), the device will be monitoring weather conditions of the forest using various sensors and recordings of dramatic increases in atmospheric temperatures, decreases in soil moisture levels, and changes in barometric pressures.



### RESOURCES NEEDED FOR SCALE-UPS

- [SenseCAP A1101 – LoRaWAN Vision AI Sensor](#) to measure biomass and detect the presence of humans and animals

### LEARN MORE

[https://www.hackster.io/user102774/fight-fire-wild-fire-prediction-using-tinyml-df7572?auth\\_token=0cfca33c158bc56fd1940f3de122f9b6](https://www.hackster.io/user102774/fight-fire-wild-fire-prediction-using-tinyml-df7572?auth_token=0cfca33c158bc56fd1940f3de122f9b6)

### CONTRIBUTE

[Salman Faris \(farissalmanbr@gmail.com\)](mailto:farissalmanbr@gmail.com)

[Muhammed Zain](#)



# Project Agouti

Project Makers: **Team Enigma (Yiding Song, Dylan K)**  
Sustainability Topic: **Wildlife Conservation**



*“If a tree falls in the forest with no ears to hear it, Agouti hears it.”*

— Team Enigma

## CHALLENGE

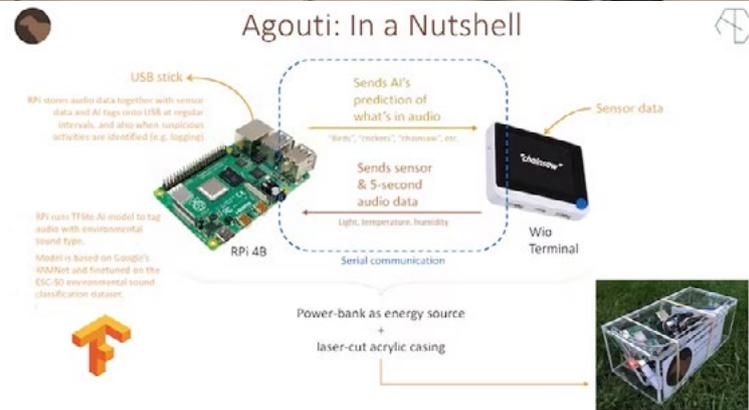
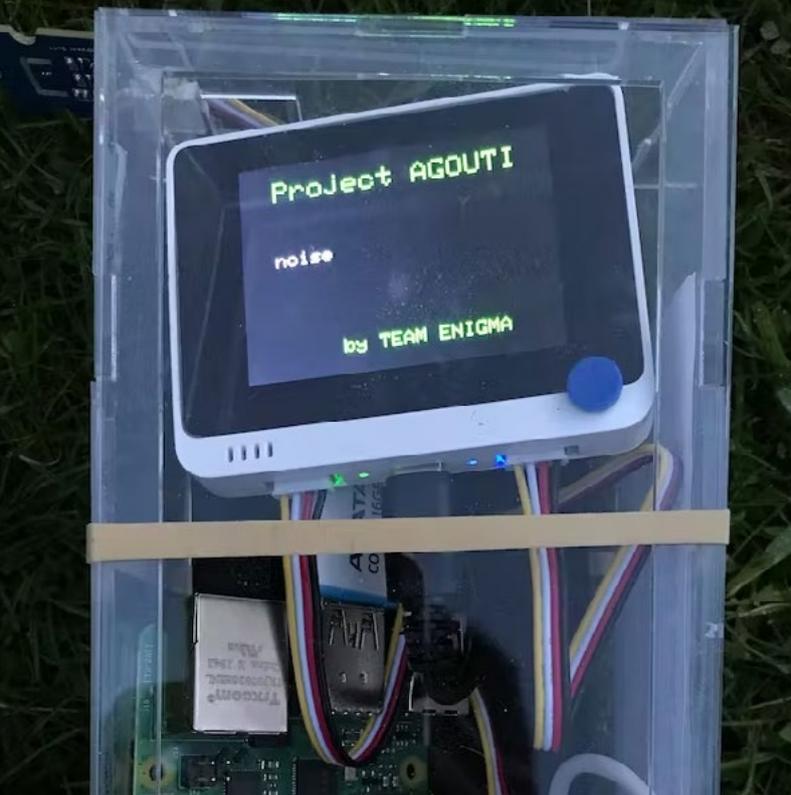
Traditional vision-based wildlife monitoring methods are limited by weather conditions, the camera’s field of view, the size of target organisms, and their proximity. There is great room for alternative technologies which can monitor wildlife more reliably through other channels: like acoustic monitoring. This offers a reliable, low-cost, and scalable alternative to monitor wildlife, with the added bonus of detecting harmful human activity: whilst poaching and logging may be impossible to see, they are much easier to hear.

## METHODS

Project Agouti is an intelligent, weatherproof acoustic monitoring device that can be easily deployed in the wild to record and analyze wildlife species’ audio data. The project deployed Edge ML to automatically classify the audio data into classes like insect sounds, bird chirping sounds, human activities (ex. vehicle and talking sounds), and logging (ex. chainsaw noises). At the same time, environmental data — like temperature, humidity, and light — are recorded and linked with the audio classifications, so as to quantify exactly how the environmental conditions influence various species’ behaviors.

## RESULTS

The AI model performance of the prototype for different audio classes has demonstrated about 60% of the accuracy rate. Although it is not 100% accurate yet, the goal of Team Enigma is to improve the existing prototype by adding and narrowing down important audio recordings for further analysis, so as to help conservationists to monitor natural habitats. Ultimately, Team Enigma’s final product is a smart, portable system that can be put outdoors to monitor habitats by ‘listening’ to various audio types. Such a product has a potential of saving 5-seconds audio clips onto a USB periodically; it also records any abnormal activity, like vehicle or chainsaw



noises. Each audio clip is tagged with the AI's classifications (e.g. birdsong, rain, chainsaw, etc.), environmental data, and a timestamp. They believe that these data can give conservationists valuable insights on the state of the habitats, biodiversity, changes over time, and whether it is under threats from intrusive, artificial activities. Crucially, they will integrate the data-collection capability of IoT systems with AI Machine Learning, in order to create a system which tags a huge quantity of audio data for key classes, speeding up conservationists' workflow.

### RESOURCES NEEDED FOR SCALE-UPS

- Conservation partners to test and deploy our system in real-life habitats
- Access to audio data from real habitats for more accurate and targeted AI classifications
- Industrial-grade computing infrastructures to train more accurate AI models
- Higher fidelity microphone to boost data quality
- Guidance on porting models onto a low-consumption PCB, integrating solar panels for continuous usage, adding LoRaWAN for remote monitoring

### LEARN MORE

[https://www.hackster.io/team-enigma/project-agouti-df34a4?auth\\_token=c395958313d48c007a6c07517b7f8b0d](https://www.hackster.io/team-enigma/project-agouti-df34a4?auth_token=c395958313d48c007a6c07517b7f8b0d)

### CONTRIBUTE

Yiding Song (neutrino@gmail.com)



# Edible Algae Growing Cycle Monitor

Project Makers: **Stephen Kruglewicz**

Sustainability Topic: **Climate-Smart Commodities**



*“Spirulina Algae is a superfood with all the nutrition value to sustain human beings.”*

— Stephen Kruglewicz

## CHALLENGE

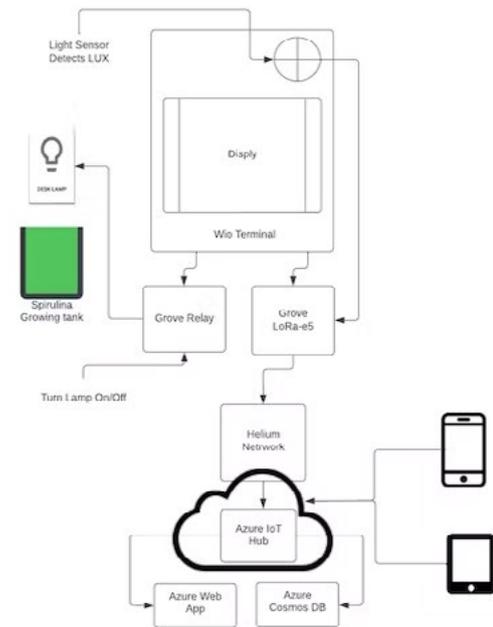
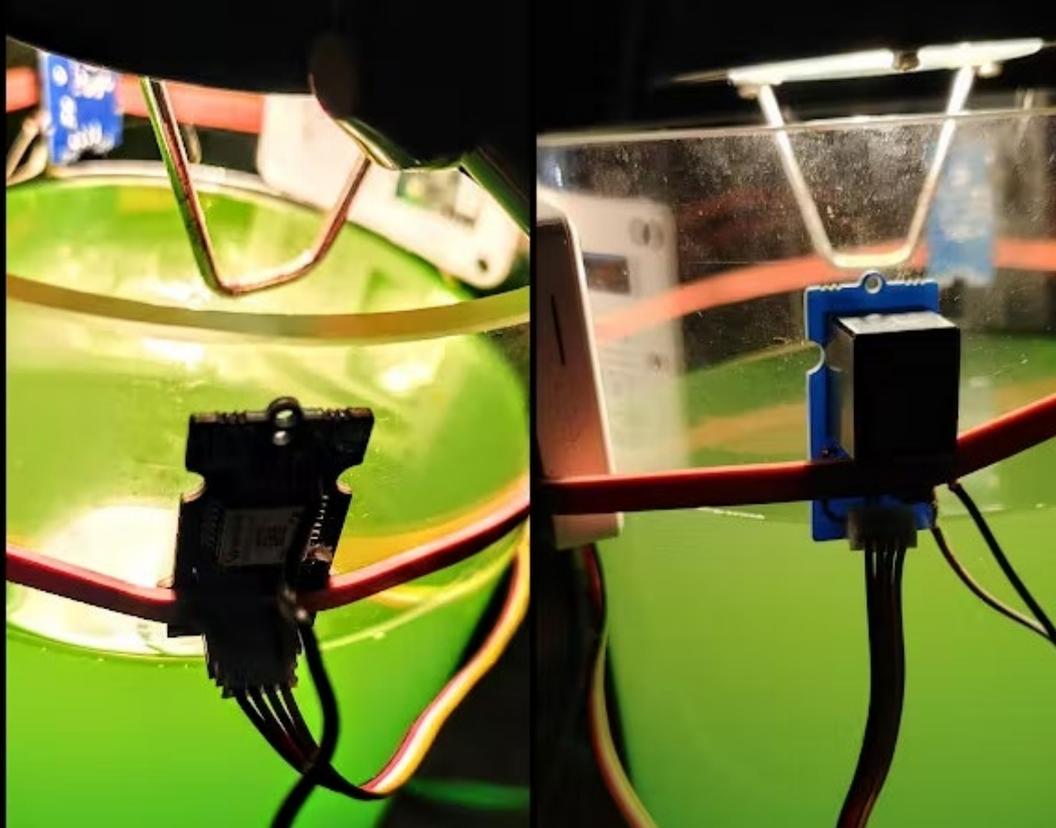
A monitoring system can be helpful for the successful growth of any algae. Any environmental parameters that require manual maintenance (water temperature, oxidation, PH, Light exposure, status of the growth) can be monitored and reported. Although growing algae is simple, there are a lot of things that need to be measured and maintained during the growing process. For example, amount of light exposure, water temperature, water oxidation, PH level, enclosure, and so on. Machine learning can be used to learn to detect some of ideal measurements during the growing cycle.

## METHODS

The project is mainly focused on remotely monitoring Spirulina Algae’s growth by creating an ideal environment for its cultivation with [Wio Terminal](#), [Grove — E5 LoRa Module](#) and other Grove sensors in [SenseCAP K1100 Kit](#), [Helium Network](#), and [SenseCraft v0.2](#). Environmental elements like water temperature, oxidation level, PH, amount of light exposure, enclosure environment, status quo of the growth can be monitored and reported. This system is portable enough to operate anywhere in the world where there is a LoRaWAN connection. By adopting a Machine Learning model, Spirulina Algae can be produced more efficiently, using the minimized amount of natural resources.

## RESULTS

The challenge was to gather, analyze, and use the Telemetry data from a monitoring system. For this challenge, the maker chose to design and implement a subsystem of an entire solution that he will continue to design and develop. He decided to take a Light Exposure subsystem as a start to a complete monitoring system. This subsystem maintains light exposure for growing Spirulina. It will assure that the spirulina gets the recommended amount of light every day to



improve the growth rate. For example, studies have shown, to improve the growth rate, a light can be turned ‘on’ every hour for 45 minutes and ‘off’ for 15 minutes, from 7am to 10pm every day.

### RESOURCES NEEDED FOR SCALE-UPS

- [Grove – AI Module](#) to detect when the algae is ready to be harvested and send an alert to notify this status quo
- SenseCraft firmware with Helium Network connection
- Get the Helium data to Azure IoT Hub to visualize the data

### LEARN MORE

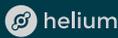
<https://www.hackster.io/skruglewicz/edible-algae-growing-cycle-monitor-bca939>

### CONTRIBUTE

Stephen Kruglewicz (skruglewicz@gmail.com)



Helium Award



# Volcano Activity Monitoring System for Residents and Climber

Project Makers: **Tri Susanto**

Sustainability Topic: **Natural Disaster Monitoring**



## CHALLENGE

*“Indonesia is a country located on the Ring of Fire, which causes a lot of volcanism to occur. The number of volcanic mountains that are still active in Indonesia makes it necessary to be aware of volcanic eruptions. ... [Because of] The lack of information about the conditions at the top of the mountain, which includes some dangerous toxic gas activity and potential volcanic eruptions, climbers do not know the actual conditions at the peak, so they cannot decide whether the climb is continued or not.”*

— Tri Susanto

## METHODS

By utilizing LoRaWAN for long-distance communication, the project prototype is a device that can monitor the accurate conditions of mountain tops with risks of volcanic eruptions. The device will capture various gas data that can be dangerous to climbers and nearby residents. After detecting such risks, the device will instantly send a signal to the device that climbers or residents have with them. This device was developed using [Wio Terminal](#), [SenseCAP K1100 Kit](#), [Seeed Studio XIAO SAMD21](#), and [Seeed Studio XIAO Expansion Board](#).



### LEARN MORE

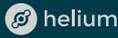
[https://www.hackster.io/tri-susanto/volcano-activity-monitoring-system-for-residents-and-climber-c14a32?auth\\_token=526dee0f8825bb440c8e342976b1e086](https://www.hackster.io/tri-susanto/volcano-activity-monitoring-system-for-residents-and-climber-c14a32?auth_token=526dee0f8825bb440c8e342976b1e086)

### CONTRIBUTE

[Tri Susanto](#)



Helium Award



# Trail Conservation NFT

Project Makers: MD R. Islam

Sustainability Topic: Health



## CHALLENGE

*“Hiking is really fun, but sometimes hiking trails are used so often that the local ecosystem can be put at risk.”*

— MD R. Islam

## METHODS

The goal of this project was to make a reward system for hikers for reporting the status quo of trail conditions in addition to collecting various environmental sensor information about the trail tracks with Wio Terminal deployed in various hiking locations. This has been implemented by using Grove — LoRa—E5 and Grove — AI Vision Sensor.

## LEARN MORE

<https://www.hackster.io/exp0nge/trail-conservation-nft-7ac81d>

## CONTRIBUTE

[MD R. Islam](#)

# V. What Are Other Noteworthy Projects?

Early Flash Flood Warn System

Livestock / Wildlife Counting from Drone with FOMO algorithm

Surface Crack Detection and Localization w/ Seed reTerminal

UrbanIoT – Mobile Environmental Monitoring

LoRa-Enabled Smart Agriculture and Animal Husbandry System

Vision based Sand Depletion Prevention Kit (VSDP)

Biofloc Monitoring System (Powered By: Wio Terminal)

How to Monitor a Beehive with Arduino Nano 33BLE (Bluetooth)

Portable Vehicle to Monitoring Marine Pollution



# Early Flash Flood Warn System

Project Makers: Jhonattan Moreno

Sustainability Topic: Natural Disaster Prevention and Mitigation



## CHALLENGE

“Year after year, in the Andean region of South America, there are emergency situations due to flash floods that take the civilian population by surprise. ... It is true that there are some solutions in early warning systems, however these solutions tend to be expensive (in investment, space occupation and maintenance).”

– Jhonattan Moreno

## METHODS

The project is about devising a low-cost solution prototype that can trigger early warnings for floods and avalanches through monitoring relevant environmental parameters and send out warning messages for the public and trigger emergency actions from the authorities. By using Wio Terminal and Grove – Vision AI Module, water flows are monitored in real time, and once the amount of water flows exceeds a certain amount of detection rate, then alert emails will be sent through the BLYNK platform.

## RESULTS

When a flash flood is detected, Wio Terminal will generate an alert, which will be followed by an AI vision’s detection system results. The alert is issued via emails to a predefined list of recipients, and will be visualized on websites to issue massive alerts via social networks and authorities.

## LEARN MORE

[https://www.hackster.io/mrmolex/early-flash-flood-warn-system-8cfdee?auth\\_token=65e97cb6cd63b01ec42300df89a18b86](https://www.hackster.io/mrmolex/early-flash-flood-warn-system-8cfdee?auth_token=65e97cb6cd63b01ec42300df89a18b86)

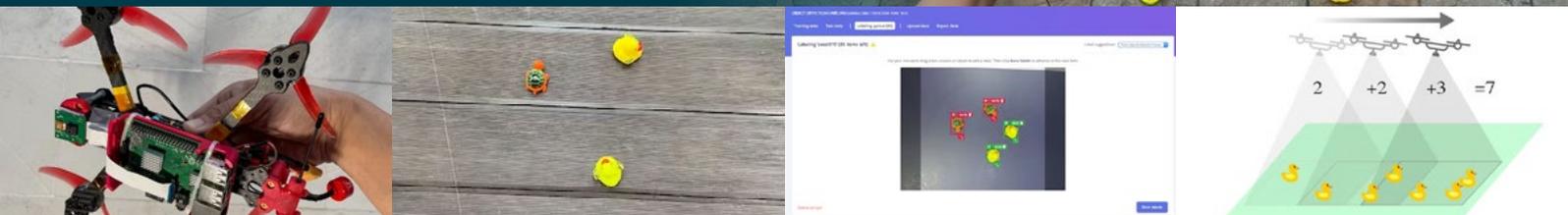
## CONTRIBUTE

[Jhonattan Moreno](#)

# Livestock / Wildlife Counting from Drone with FOMO algorithm

Project Makers: Jallson Suryo

Sustainability Topic: Wildlife Conservation & Precision Agriculture



## CHALLENGE

*“The role of Artificial Intelligence for livestock and wildlife monitoring is expected to grow significantly.”*

– Jallson Suryo

## METHODS

This project demonstrates how AI can be employed for counting and monitoring livestock animals and wildlife species in an efficient way through embedded Machine Learning’s object detection technology. By using Computer Vision on a drone flying across the field (scanning down the surface) with a camera facing down, the Edge Impulse’s FOMO object detection algorithm will be able to detect and distinguish different types of animals, and count the cumulative number of each animal species in real-time.

## RESULTS

This simple project demonstrates how object detection technology can be used for wildlife rescue teams to monitor the population of the animals.

## LEARN MORE

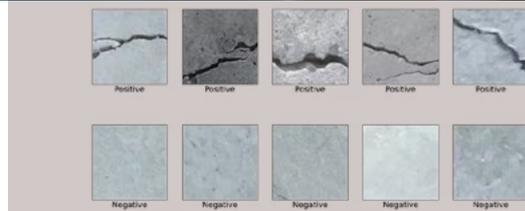
<https://www.hackster.io/jallsonsuryo/livestock-wildlife-counting-from-drone-with-fomo-algorithm-a2f734>

## CONTRIBUTE

[Jallson Suryo](#)

# Surface Crack Detection and Localization w/ Seed reTerminal

Project Makers: Naveen Kumar  
Sustainability Topic: Building Collapse



## CHALLENGE

“A 50-year-old bridge collapsed in Pittsburgh (Pennsylvania) on January 28, 2022. There is only one reason why a sturdy structure such as a concrete bridge could suddenly collapse: wear and tear. Concrete structures generally start deteriorating after about 40 to 50 years. For this reason, overlooking signs of wear can result in severe accidents, which is why the inspection and repair of concrete structures are crucial for safeguarding our way of life. Cracks are one of the important criteria used for diagnosing the deterioration of concrete structures. Typically, a specialist would inspect such structures by checking for cracks visually, sketching the results of the inspection, and then preparing inspection data based on their findings. An inspection method like this is not only very time-consuming and costly but it also cannot accurately detect cracks.”

– Naveen Kumar

## METHODS

The project prototype is an reTerminal- and 'Edge Impulse' Computer Vision-based system using an image classification model – that can detect and localize the surface cracks in concrete structures and buildings for predictive maintenance, before any hazardous accidents occur. The CNN (Convolutional Neural Networks) with GAP (Global Average Pooling) layers that have been trained for a classification task is used for object localization, because GAP-CNN not only tells us what object is contained in the image, but also where the object is in the image – without human inputs.

## RESULTS

The prototype has been reported to have a 99.6% accuracy of detecting surface cracks in concrete structures and buildings.

## LEARN MORE

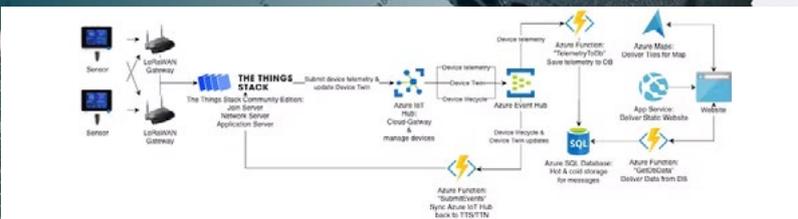
[https://www.hackster.io/naveenbskumar/surface-crack-detection-and-localization-w-seed-reterminal-774da0?auth\\_token=c0b0e09d2f9fa9dcecb0bed83a00aef0](https://www.hackster.io/naveenbskumar/surface-crack-detection-and-localization-w-seed-reterminal-774da0?auth_token=c0b0e09d2f9fa9dcecb0bed83a00aef0)

## CONTRIBUTE

[Naveen Kumar \(naveen.bs.kumar@gmail.com\)](mailto:naveen.bs.kumar@gmail.com)

# UrbanIoT - Mobile Environmental Monitoring

Project Makers: Philipp Manstein, Caronosaurus  
Sustainability Topic: Environmental Conservation



## CHALLENGE

“Stationary sensors only measure the environmental data on one specific location. So if you want to achieve the environmental monitoring of a whole city, you need a lot of sensors, which is expensive, complicated in maintenance and, as mentioned above, only senses the environmental data of one location in the city.”

– Philipp Manstein, Caronosaurus

## METHODS

This project prototype aims to enable citizens to understand their living environment and environmental challenges better, by carrying a low-cost and portable device on their backpacks, bikes, scooters, and electric vehicles. The device measures various environmental parameters of the whole city, by embedding Wio Terminal, SenseCAP K1100 Kit, Grove – Sunlight Sensor, Grove – GPS, Grove – Laser PM2.5 Dust Sensor, Microsoft Azure, and The Things Network together as one AIoT solution.

## RESULTS

The Grove sensors will collect environmental data and send them to the gateways nearby via LoRaWAN. The gateways are connected to The Things Network (TTN). TTN handles the LoRa connections and transfers the data to the Microsoft Azure cloud, using the Azure IoT Hub as a gateway to the cloud. In the cloud the data gets processed via Azure Functions and saved to an Azure SQL Database. Afterwards, the collected data will be visualized on a website using Azure Maps.

## LEARN MORE

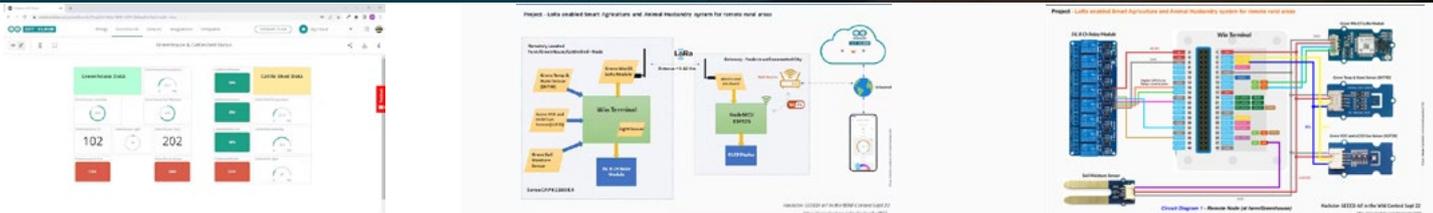
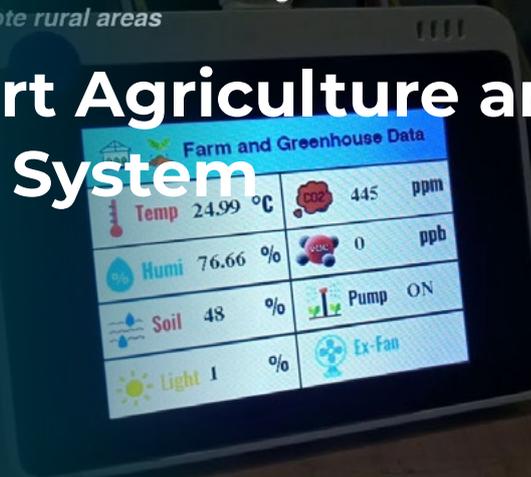
[https://www.hackster.io/484002/urban-iot-mobile-environmental-monitoring-421463?auth\\_token=d7e21a509d2561c7a9e0403c97eb33eb](https://www.hackster.io/484002/urban-iot-mobile-environmental-monitoring-421463?auth_token=d7e21a509d2561c7a9e0403c97eb33eb)

## CONTRIBUTE

Philipp Manstein (philipp.gm@googlemail.com)

# LoRa-Enabled Smart Agriculture and LoRa Animal Husbandry System

Project Makers: Mahesh Yadav  
Sustainability Topic: Precision Farming



## CHALLENGE

“Agriculture and animal husbandry is one of the most common sources of income for most of the population of rural life in India. ... there is no connectivity of Internet/ Cellular services [in general]. These areas come in shadow regions of connectivity. Also, due to very few subscribers/consumers in such areas, telecom companies also hesitate to deploy any dedicated cellular/wireless connectivity infrastructure for them. ... Main advantage of LoRa technology ... is very easy, affordable and efficient to deploy in this scenario. Rather than using other wired (Ethernet) or wireless (GSM/NbIoT/WiFi) technologies.”

– Mahesh Yadav

## METHODS

The maker seeks to connect the rural villages, agriculture farms, and big cities through deploying LoRa technology as a gateway to the connectivity of the Internet, so that any rural farmers in the region can monitor and manage their farms and animal husbandry fields with informed environmental data analytics. This solution prototype harnessed Wio Terminal, SenseCAP K1100 Kit, Wio-E5 mini, Arduino IDE, and Microsoft VS Code.

## RESULTS

As a result, agricultural farms located in shadow regions of connectivity (no GSM/WiFi/Ethernet), and in the vicinity (5–10 km) from well-connected cities can be monitored and automated. This kind of a prototype can be useful not only for smallholder farmers but also for multi-acre farms.

## LEARN MORE

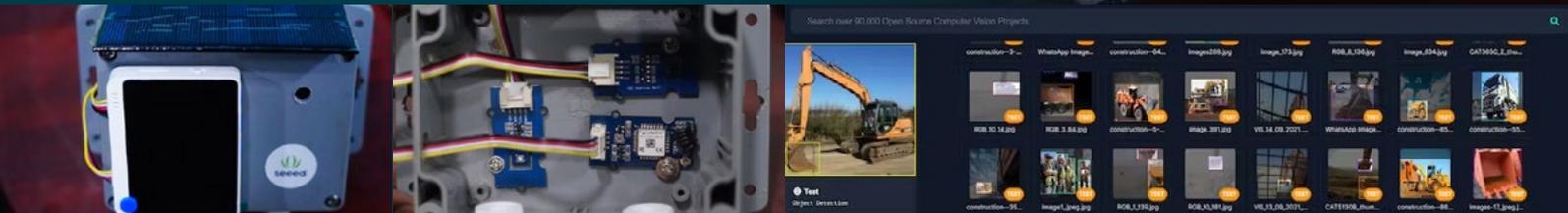
[https://www.hackster.io/maheshyadav2162/lora-enabled-smart-agriculture-and-animal-husbandry-system-332ff8?auth\\_token=659bafbb4694786c1dded2fadf8869ff](https://www.hackster.io/maheshyadav2162/lora-enabled-smart-agriculture-and-animal-husbandry-system-332ff8?auth_token=659bafbb4694786c1dded2fadf8869ff)

## CONTRIBUTE

Mahesh Yadav

# Vision based Sand Depletion Prevention Kit (VSDP)

Project Makers: Rahul Khanna D  
Sustainability Topic: Sand Mining



## CHALLENGE

*“Unsustainable sand mining from river beds can have substantial social, environmental, geomorphic, and disastrous impacts on rivers. Humanity's appetite for sand could soar 45 percent within four decades, according to researchers. ... Excessive sand mining can alter the river bed, and force the river to change course, erode banks, and lead to flooding. It also destroys the habitat of aquatic animals and microorganisms, besides affecting groundwater recharge.”*

– Rahul Khanna D

## METHODS

This project prototype can monitor the sites affected by illegal sand mining, using Wio Terminal, SenseCAP K1100 Kit, Helium Console, and Arduino IDE. It is designed to process environmental sensor data such as VOC, eCO2, soil moisture, air temperature and humidity, monitor trespassing humans in the sand depletion regions, and notify the server using the LoRaWAN gateway. In particular, the Edge AI model monitors illegal sand mining using the Grove – Vision AI Module. The collected data will be trained with Ultralytics' YOLOv5 to distinguish excavators, humans, trucks, and wheel loaders.

## LEARN MORE

<https://www.hackster.io/rahulkhanna/vision-based-sand-depletion-prevention-kit-vsdp-bde664>

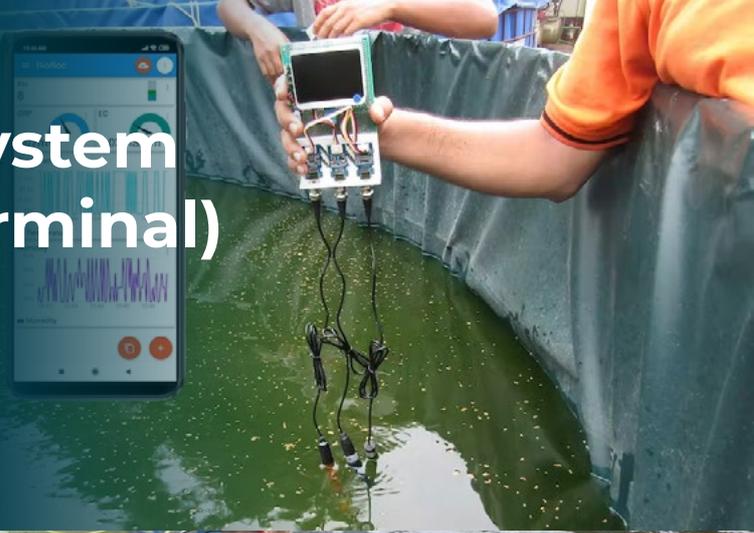
## CONTRIBUTE

[Rahul Khanna D \(rahulkhanna24.06@gmail.com\)](mailto:rahulkhanna24.06@gmail.com)

# Biofloc Monitoring System (Powered By: Wio Terminal)

Project Makers: Md. Khairul Alam

Sustainability Topic: Aquaculture



## CHALLENGE

*“In a world where more than 800 million people continue suffering from chronic malnourishment and where the global population is expected to grow by another 2 billion to reach 9.6 billion people by 2050, it is important to meet the huge challenge of feeding our planet while safeguarding its natural resources for future generations. In this context, aquaculture plays a key role in eliminating hunger, promoting health, reducing poverty, as well as generating jobs and economic opportunities.”*

– Md. Khairul Alam

## METHODS

This biofloc monitoring device makes continuous monitoring and tracking of temperature, pH, EC and ORP in water ecosystems, using Wio Terminal, Grove Sensors (ORP, PH, EC, temperature and humidity) along with Arduino IDE. PH measures the acidity of water, ORP (Oxidation–Reduction Potential) detects the water’s cleanliness, pollutants, and contaminants, whereas EC (Electrical Conductivity) measures electric currents in water.

## RESULTS

The collected environmental data can be visualized from the display of the Wio Terminal as well as from an Android app in real–time. If any environmental parameter reaches an unsatisfactory level, an alert will be triggered and ring the buzzer of the Wio Terminal.

## LEARN MORE

[https://www.hackster.io/taifur/biofloc-monitoring-system-powered-by-wio-terminal-b22b43?auth\\_token=5201c0f619965f1a4bd9d08ffcbff2b4](https://www.hackster.io/taifur/biofloc-monitoring-system-powered-by-wio-terminal-b22b43?auth_token=5201c0f619965f1a4bd9d08ffcbff2b4)

## CONTRIBUTE

[Md. Khairul Alam](mailto:khairul.uapstu@gmail.com) (khairul.uapstu@gmail.com)

# How to Monitor a Beehive with Arduino Nano 33BLE (Bluetooth)

Project Makers: Clément Chamayou, Jade Evrard, Margaux Launois, Jeremy Royer, Nicolas Stein  
Sustainability Topic: Wildlife Conservation



## CHALLENGE

“Our team was led to rub shoulders with beekeepers and after a few exchanges some issues appeared. Indeed, beekeepers do not always have the time to check their beehives or the weather might not be suitable (heavy rain, strong wind) for checking. Thus, they asked us if there is a way to remotely monitor their beehives. They gave us the technical specifications we would have to meet and we started to design a solution for them.”

– Clément Chamayou, Jade EVRARD, Margaux Launois, Jeremy Royer, Nicolas Stein

## METHODS

The project is about monitoring the beehive’s environmental parameters so as to optimize the living environment of bees by minimizing any environmental risks that may cause their death. This project prototype is focused on gaining data of the atmospheric temperature and humidity of the inside and outside of the beehive, as well as weight of the beehive. The collected data is then uploaded to Ubidots, which is a cloud interface allowing beekeepers to consult the data and the state of the beehive.

## RESULTS

All in all, temperature, humidity, weight, light, and battery data are all displayed on a web platform and app in both real-time and chronological manners.

## LEARN MORE

[https://www.hackster.io/clementchamayou/how-to-monitor-a-beehive-with-arduino-nano-33ble-bluetooth-eabc0d?auth\\_token=77a70182f8e813c245ab22da3e70a39f](https://www.hackster.io/clementchamayou/how-to-monitor-a-beehive-with-arduino-nano-33ble-bluetooth-eabc0d?auth_token=77a70182f8e813c245ab22da3e70a39f)

## CONTRIBUTE

[Clément Chamayou \(clementchamayou@gmail.com\)](mailto:clementchamayou@gmail.com)

# Portable Vehicle to Monitoring Marine Pollution

Project Makers: **Dhadhang SBW**  
Sustainability Topic: **Marine Pollution**



## CHALLENGE

*“Currently, marine habitats are under threat of pollution that impacts on many human activities and human life. The increasing concern about pollution levels in the oceans and coastal areas has led to various approaches to measuring and reducing marine pollution, in order to achieve sustainable seawater quality. ... Some of the existing solution methods are static installations such as ocean buoy installations, [but] the conditions for other areas cannot be tracked.”*

– Dhadhang SBW

## METHODS

This project is a “mini hull boat” equipped with features of an autonomous surface vehicle, and a manual mode with remote controls to direct the hull towards certain locations. Inside the mini hull boat, the maker deployed Seeed Studio XIAO RP2040 and Grove – LoRa Radio, along with other IoT sensors that measure turbidity, PH level, and temperature. Outside the mini hull boat, Wio Terminal and another unit of Grove – LoRa Radio have been employed. Arduino IDE and Edge Impulse have been used to code the system and visualize data respectively.

## LEARN MORE

[https://www.hackster.io/sekolahrobot/portable-vehicle-to-monitoring-marine-pollution-11ec16?auth\\_token=6e73c9a5112131db371f19092af1428e](https://www.hackster.io/sekolahrobot/portable-vehicle-to-monitoring-marine-pollution-11ec16?auth_token=6e73c9a5112131db371f19092af1428e)

## CONTRIBUTE

[Dhadhang SBW](#)



## VI. What Are the Next Steps?

### 6.1 Judges' Reflections on IoT2Wild Contest

*"The objective of this contest was to show us the power of AI, IoT, and Edge Computing for saving the Earth and biodiversity. ... We have been truly impressed with the breadth of solutions submitted covering all aspects of planetary threats! ... Submissions covered everything from precision farming, insect- and algae based protein production, early detection of wildfires, harmful algae, and severe weather, to monitoring volcanoes/oceans/skies/crops, to acoustic monitoring of protected areas, to tracking endangered wildlife species. You name it, and numerous amazing solutions were submitted."*

– Bastiaan den Braber,  
Founder of Zambezi Partners

*"The innovation and determination displayed in these projects is truly inspiring! From tackling air pollution to conserving water resources and creating sustainable food supplies through smart agriculture, these projects demonstrate the boundless potential of the Helium Network to drive positive change and address pressing environmental issues. I am endlessly excited for these builders to continue to innovate and tackle the challenges ahead of us and build a sustainable future for all."*

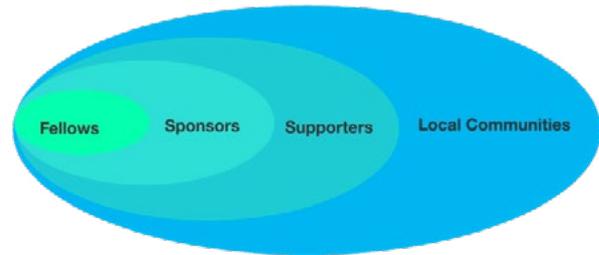
– Joey Hiller,  
Technical Director at Helium Foundation

*"Contests like this offer the opportunity for any innovators outside the formal and traditional structures to contribute to building a better relationship between technology and ecology. For me, it is not only important to protect and preserve our species, but also to regenerate them, so I hope that these solutions inspire even more designers and makers to come up with ideas to build alternative futures for our planetary life."*

– Tomas Diez Ladera,  
Founding Partner and Executive Director of the Fab City Foundation;  
Co-Director and Board Member of the IAAC

## 6.2 Going Beyond: IoT Into the Wild Initiative

Since 2022, Seeed Studio has been running an ambitious “IoT Into the Wild Initiative” (IoT2Wild Initiative), which is an open source, community-driven, and global initiative to bring scalable technology solutions into the wild. It is a newly-arising multi-stakeholder community and platform for people who are dedicated to apply AIoT solutions for the most pressing issues of our time: Environmental Conservation, Wildlife Conservation, Climate Crisis, Carbon Neutrality, Agriculture, Energy, Food, and so on.



IoT2Wild Initiative seeks to become the leading action-oriented multi-stakeholder platform for scaling up IoT and AI solutions in the wild: Together with collaborators, Seeed Studio seeks to invite a more diverse range of stakeholders from multiple sectors and spheres to join this ambitious initiative as Fellows. Through this Fellowship program, Seeed Studio hopes to bring and stay united with technologists and innovators from companies and non-profit organizations; conservationists and environmentalists from academia and civil society organizations; as well as policymakers and investors from international organizations, for taking concerted actions towards the 2030 Agenda of the UN’s SDGs. On this background,

1. Join IoT2Wild Initiative
2. Share the real-world’s latest needs from the field
3. Exchange information and networks for ready-to-deploy technological solutions
4. Share best practices
5. Exploring opportunities to build trans-sectoral partnerships for pilot and scale-up projects

Together with key opinion leaders, Seeed Studio will minimize costs and complexity of scalable solution developments so that the much-needed solutions can be deployed and scaled up in the field, so as to preserve our natural world.

If you are interested in joining as a Fellow, reach out to Seeed Studio at [branding@seeed.cc](mailto:branding@seeed.cc)!

## 6.3 Seeed Studio’s Conservation IoT Products

If you are from academia, NGOs, social enterprises, foundations, and international organizations striving to solve conservation challenges and other various sustainability challenges in the wild with technological solutions, feel free to learn about Seeed Studio’s off-the-shelf, industrial-grade AIoT solutions. They are often referred to as ‘IoT2Wild products’, which consist of ready-to-use, full-stack hardware and software products: <https://www.seeedstudio.com/device>

## VII. About Seeed Studio

Seeed Studio is a global IoT hardware partner for digital innovators. Since 2008, they have been working closely with global technology ecosystems to provide hardware modules, devices and related services. They integrate the latest technology into thousands of open source hardware modules, so that millions of developers, makers, and innovators coming from different backgrounds can innovate interdependently.

With professional and industrial expertise in Embedded Machine Learning, Edge Computing, LoRaWAN sensors and networks, their ready-to-deploy products are increasingly accelerating myriads of emerging digital solutions in the real world. On this backdrop, their work has been well recognized by both – technology and mainstream media, thanks to their avid services for precision agriculture, smart cities, STEAM education, environmental and meteorological monitoring, scientific researches, smart energy, digital factory, and smart retail, to mention a few.

To continue supporting decentralized and sustainable innovation, they founded “[Chaihuo x.factory](#)”, and started China’s first Maker Movement in 2012 by annually organizing “[Maker Faire Shenzhen](#)”. Stay connected with Seeed Studio on [Discord](#), [LinkedIn](#), [Facebook](#), [Twitter](#), and [Instagram](#).





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**IoT2Wild Products**

[@For NGOs & IOs](#)

[@For Companies](#)



**Open Tech Project Hub**

[hackster.io/seed](http://hackster.io/seed)



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**YouTube**

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