Indian Institute of Technology-Ropar

IIT- Technology and Innovation Foundation(AWaDH)

Website: https://ihub-awadh.in/

Technology: Biodiversity Sensor

Expression of Interest (EOI) for Collaboration/Adoption of Biodiversity Sensor

Deployed by: IIT Ropar-TIF AWaDH
Domain Coordinator: Dr. Suman Kumar
TRL Level: 8

About iHub – AWaDH: iHub – AWaDH (Agriculture and Water Technology Development Hub) is a premier innovation center established under the **National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS) by the Department of Science and Technology (DST), Government of India, at IIT Ropar.**

With **₹110 Cr funding**, iHub – AWaDH is dedicated to advancing deep-tech research, innovation, and entrepreneurship in agriculture, water, IoT, and cyber-physical systems. The hub provides comprehensive support for R&D, incubation, and acceleration of technology-driven startups and solutions, focusing on sustainable agriculture and environmental resilience.

Biodiversity Sensor

Welcome to the world of advanced environmental monitoring with the Biodiversity Sensor. This innovative device combines cutting-edge technology with environmental stewardship, using cameras, audio, and environmental sensors to track temperature, humidity, and light. With real-time data transmission through 4G connectivity, the Biodiversity Sensor simplifies and enhances the monitoring of ecosystems, contributing to the protection and preservation of our planet's invaluable biodiversity.

The Biodiversity Sensor Project focuses on developing advanced sensors to monitor and analyze insect species in their natural habitats. The sensor captures environmental and biological data, such as insect activity, at regular intervals and transmits it to the cloud. Using AI-powered algorithms, it identifies specific insect species with high precision. This technology is designed to support biodiversity studies, conservation efforts, and ecological research by providing real-time, accurate, and scalable monitoring solons.

Purpose of the Sensor

The Biodiversity Sensor is purpose-built to monitor and evaluate the variety and abundance of living organisms within specific ecosystems or environments. It empowers researchers, conservationists, and policymakers to:

- Understand ecosystem health and dynamics.
- Track changes over time.
- Make data-driven decisions for conservation and sustainable land management practices.

By detecting and quantifying species present in an area, this technology aids in preserving biological diversity and promoting the sustainable management of natural resources.

Overview of Sensor Capabilities

The Biodiversity Sensor represents a transformative advancement in environmental monitoring technology, offering a robust suite of features to bridge the gap between modern technology and environmental conservation.

Key Features

Modular Design: The sensor is designed with three main components:

1. Main PCB – Handles core functions and data processing.
2. Power PCB – Manages power usage and ensures energy efficiency.
3. Camera – Captures high-resolution images for detailed visual analysis.

Centralized Controller: A central controller serves as the intelligence behind the sensor, seamlessly managing all functions including camera and environmental sensors such as temperature, humidity, and light intensity.

Power Management: A dedicated power management system optimizes energy efficiency, ensuring reliable operation in diverse environmental conditions.

High-Resolution Camera: The high-resolution camera captures images of insects and other living organisms, providing valuable data for biodiversity analysis and monitoring.

4G Connectivity

- **Real-Time Data Transmission:** Enables instant data transfer and remote access for efficient monitoring.
- **Cloud Integration:** Facilitates seamless transfer of data from the device to IoT cores, with storage in S3 Buckets for analysis.
- **Redundancy:** Camera sensor data is also stored locally on an SD card for backup and redundancy.

User-Friendly Interface: The sensor is equipped with an intuitive interface, ensuring easy configuration, operation, and maintenance for users of all skill levels.

Getting started with package instructions

The following items listed below will be found while unpacking the device.

1. Device

2. Solar panel

Specifications:

- **Brand:** Solar Universe India
- **Panel Type:** Polycrystalline
- **Rated Power:** 200 W
- **Voltage:** 12 V
- **Cables Length:** 3 m

3. 5V adapter

Specifications:
AC input voltage: 100V - 240V, 50Hz / 60Hz
Output DC Voltage: 5V
Output Current: 2A

4. Extender for tripod stand

5. SIM

<u>Installation instruction:</u>

- Battery is to be inserted according to the polarity
- We are plugging in the DC adaptor because newly purchased batteries
- have a negligible amount of charge. (Note: The device must be powered
- with DC adaptor for 1 hour)
- Place the device in the desired location.
- Mount the device as per your convenience on the tripod or any other setup.
- Plug the solar connector.

<u>Specifications</u>

Battery information and troubleshooting

● No troubleshooting needed

Model No.	ICR18650
Capacity (mAh)	2600
Charge Rate (C)	2
Discharge Rate	2C
Nominal Voltage (V)	3.7
Maximum Charge Voltage (V)	4.2
Maximum Discharge Current (A)	5.2
Chemistry	ICR
Length (mm):	65
Width (mm):	18
Height (mm):	18
Weight (g):	44
Shipping Weight	0.047 kg
Shipping Dimensions	8 × 3 × 3 cm

Sim card detail and specification

Kore wireless

KORE OmniSIM simplifies the complexity of achieving network access for truly global resilient coverage, navigating evolving network technologies, and managing complex logistical processes for your IoT deployments with a single eSIM.

Sensor Overview & Steps

Description of the Sensor's Physical Components:

● **Main PCB:** Houses the central controller and manages sensor functions.
● **Camera:** Captures high-resolution images of wildlife and vegetation.
● **Weather Sensors:** Measure temperature, humidity, and light intensity.

● **4G Module:** Enables real-time data transmission and remote access.
● **Power PCB:** Controls and manages power usage for efficient operation.
● **SD Card Slot:** Stores data for backup and redundancy.
● **Solar Panel:** Provides renewable energy to the sensor system, reducing reliance on external power sources.
● **Battery:** Stores solar-generated energy for continuous operation, ensuring uninterrupted monitoring even during low light conditions or inclement weather.
● **Adapter**-Connects the sensor to external power sources for charging or supplementary power during periods of low solar energy production.

Explanation of Sensor's Specifications:
● The sensor can detect a wide range of species per region or country, including insects and mammals. Currently the sensor can robustly capture Osmia Cornuta, Apis Mellifera, Bombus Terrestris, Megachille along with the species mentioned in the list of species which can be accessed by the following link.
● **Accuracy:** Depends on Data availability and quality-higher precision for commonly observed species and lower precision for rare or elusive ones.
● **Angle:** Depends on which image we are capturing.
● **Range:** The sensor can detect species within 40-50cm range.
● **Resolution:** The sensor detects the data in HD resolution.

Collaboration Partners

We propose a collaborative initiative involving esteemed partners such as:

- Syngenta Group Co. Ltd
- University of Zurich
- Biodiscovery Lifesciences Pvt Ltd
- URPP Global Change and Biodiversity
- Fraunhofer Institute for Molecular Biology and Applied Ecology
- Alliance for Biodiversity Knowledge
- INRAE France

Unique Selling Points

- **Precision and Scalability:** Designed to operate in diverse ecosystems, from dense forests to urban settings, the sensors can scale effortlessly for large biodiversity monitoring projects, offering precise species identification and environmental data collection.
- **AI-Driven Insights:** The advanced AI system processes extensive datasets to identify insect species with high accuracy, detect ecological patterns, and flag anomalies such as invasive species or declines in pollinator populations, enabling proactive conservation measures.
- **Cost-Effective Design:** Engineered for affordability, the sensors make advanced ecological monitoring accessible to a broader audience, from researchers to conservationists.
- **Battery Backup:** Equipped with reliable battery backup, the sensors ensure uninterrupted data collection, even in remote or off-grid locations.
- **Cloud Connectivity:** Seamlessly integrated with cloud platforms, the sensors ensure real-time data access from anywhere, supporting collaborative research, long-term data storage, and global biodiversity studies.
- **Multi-Parameter Monitoring:** Beyond insect detection, the sensors record critical environmental factors like temperature, humidity, and light, providing a comprehensive view of ecosystem health and dynamics.

Applications and Useability

- **Biodiversity Health Assessment:** The sensors enable precise identification and tracking of insect species across various ecosystems, providing valuable insights into the health and stability of biodiversity.
- **Discovery of Rare or Unknown Species:** Leveraging AI, the system can identify rare or previously unknown insect species in their natural habitats, advancing ecological research and expanding species databases.
- **On-Farm Biodiversity Monitoring:** Farmers can track their on-farm biodiversity, understand how weather impacts local ecosystems, identify the presence of beneficial predators, and determine the optimal timing for pesticide use, promoting sustainable agricultural practices.
- **Socio-Economic Benefits:** The ability to detect and analyze insect populations using advanced sensors facilitates targeted and effective pest management strategies. This can contribute to improved crop yields, economic benefits, and increased ecotourism opportunities through effective conservation and environmental management.
- **Advancing Scientific Knowledge:** Researchers can leverage the wealth of real-time data generated by the sensors to study species behaviors, ecological

interactions, and responses to environmental changes, driving innovations in biodiversity and ecological research.

Commercialization Status

Deployed in: The Biodiversity Sensor has already been deployed in 30+ locations globally multiple locations, including

- Spain
- Germany
- France
- United Kingdom
- India (Nasik)

Target Audience/Beneficiaries

- **Environmental and Conservation Organizations:** Utilize sensor data to monitor ecosystems, track species populations, and support conservation efforts effectively.
- **Ecologists and Researchers:** Benefit from real-time data and AI-driven analysis for studying biodiversity, ecosystems, and environmental changes.
- **Government Agencies:** Enhance biodiversity monitoring programs and inform conservation policies at local, national, and international levels.
- **Wildlife Reserves and Protected Areas:** Implement sensors for ongoing species monitoring and ecological health assessments in protected environments.
- **Agriculture and Farming Communities:** Use the technology to monitor pollinators and pests, aiding in informed crop management and sustainable agricultural practices.
- **Universities and Research Institutions:** Adopt the sensors for field studies, experiments, and long-term ecological monitoring in academic research.
- **Non-Governmental Organizations (NGOs):** Integrate the sensors into biodiversity, sustainability, and climate change monitoring and reporting efforts.