विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF SCIENCE & TECHNOLOGY

AWaDH
IIT Ropar-TIF

Digital Entomologist

Technical Brief

Ref No: TechBrief/2025/04

Technology Summary

The Digital Entomologist is an AI-enabled, solar-powered, field-deployable biodiversity sensor designed to autonomously detect, classify, and quantify insect species with over 90% accuracy. Developed by IIT Ropar TIF AWaDH under the NM-ICPS program, it integrates motion-sensing cameras, YOLOv5-based deep learning, and IoT connectivity to provide real-time biodiversity data. Initially focused on bee pollinator monitoring, the device now supports precision pest management, pollinator conservation, and biodiversity indexing across diverse agricultural ecosystems.

Background

Traditional insect biodiversity monitoring methods in agriculture are manual, labour-intensive, and lack scalability. With challenges like pollinator decline, pest outbreaks, and climate change, real-time, scalable biodiversity monitoring is essential. India's dependence on conventional farming methods and rising ecological threats necessitated a shift to a digital, AI-powered system capable of providing actionable data to support food security and ecosystem conservation.

Technology Description

The Biodiversity Sensor is a compact, solar-powered device equipped with a high-resolution motion-detection camera, nRF5340 microcontroller, 4G connectivity, and cloud integration. It autonomously captures insect images, processes them using YOLOv5 and CNN models, and transmits data to a cloud-based analytics platform. Trained on global datasets (GBIF, iNaturalist) and field images, the AI achieves >90% species detection accuracy. The rugged, weatherproof device supports continuous 24/7 operation in diverse farm conditions and has been deployed across India, USA, Germany, Australia, and other countries.

Market Potential / Proposed Deployment

- Global Digital Agriculture Market: USD 22.1 B (2024) → USD 64.5 B (2032) | CAGR ~14% (Precision AgTech segment).
- Agricultural IoT & Sensors Market: USD 14.3 B (2023) → USD 35.7 B (2030) | CAGR ~13.8%.
- Biodiversity Monitoring Market: Emerging niche within environmental IoT, expected double-digit growth as part of the USD 400 B smart agriculture market by 2030.
- India: High potential due to 42% workforce in agriculture, government focus on precision farming, and pollinator conservation initiatives.

Applications

- Precision pest management to reduce pesticide use.
- Monitoring and protecting pollinator populations.
- Creating biodiversity indices for sustainable agriculture.
- Supporting climate-resilient, data-driven farming practices.
- Conservation programs for ecosystem health and habitat protection.

Value Proposition

- Real-time data: Enables immediate action on pest and pollinator dynamics.
- Autonomous and scalable: 24/7 operation with minimal human intervention.
- Eco-friendly: Supports sustainable, chemical-free pest management.
- Cost-effective: Reduces crop loss and pesticide costs.
- Actionable insights: Bridges gap between field ecology and policy decisions.

Technology Status

- TRL Level: 7–8 (pilot-to-commercial stage).
- Deployed: Over 100+ devices across 10+ countries, including India, USA, Germany, and Australia.
- Future Roadmap: Integration with autonomous drones and robotic pollination systems, expanded AI models for more insect species, and large-scale networked biodiversity monitoring.