APID Edge/Hybrid System

Extreme Edge Field Science Instrument (A Brownfield Platform for Licensed Developers)

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System Overview

BioNAV's patent-pending **APID process** (*Adaptive Particle Identification & Detection*) defines a computer vision-to-filter methodology for analyzing airborne particles captured in filters, on surfaces, or through other air handling collection methods. The **APID Foundation Starter Kit** demonstrates this process as a portable air particle analysis platform—enabling field technicians to assess allergens in HVAC filters, or researchers to perform lab-grade classification with scientific imaging systems. Designed for standalone edge deployment, APID scales seamlessly into enterprise networks where multiple units report to centralized dashboards. This starter kit provides licensed manufacturers a development foundation to build their own industry-specific solutions.

Key Capabilities

Capability	Description
Field Detection & Training	Identify unknown particles on-site; train new classes in minutes without cloud
Multi-CV (Computer Vision) Input Support	USB cameras, RTSP streams, GigE Vision industrial cameras, video file upload
Dataset Management	Load from SATA storage or import; export for lab refinement or team sharing
Alert Notifications	Configure class-specific alerts with custom messages for critical detections
Session Reporting	Comprehensive reports: detections, training activity, QC metrics, PDF export
Enterprise Scalable	Edge-to-cloud architecture; satellite-ready for remote deployments

Technical Specifications

Hardware Platform

- NVIDIA Jetson Orin Nano Super (8GB RAM, 67 TOPS AI performance)
- Low power operation: 25W TDP, compatible with solar/battery deployments
- Standard 110/120V electrical supply or remote power solutions
- SATA SSD expandable storage with automatic priority management

Software Platform

- NVIDIA JetPack SDK: CUDA, cuDNN, TensorRT for GPU-accelerated inference
- Ultralytics YOLOv8: State-of-the-art object detection neural network
- Python 3.x: Backend processing and training pipeline
- React: Browser-based user interface
- Aravis: GigE Vision industrial camera integration
- OpenCV: Image processing and video capture

Computer Vision Inputs

- USB Camera: Direct capture from webcams, microscopes, portable imaging devices
- IP/RTSP Stream: Network cameras for fixed installations
- GigE Vision: Industrial cameras (Keyence, Basler, FLIR, Allied Vision, Lucid, IDS, JAI)
- File Upload: Process video footage from mobile phones, field cameras, or lab systems

Detection & Training Performance

- Real-time inference: 15-20 FPS with GPU acceleration
- On-device training: 4-8 minutes per new particle class
- 30-second recording captures ~900 training frames
- All captured data preserved for laboratory review and refinement

Field Science Workflow

Scenario: Field team discovers unknown particle not in pre-trained dataset

1. **Capture:** Record 30-second video sample of unknown particle
2. **Train:** On-device training creates working detection model in minutes
3. **Deploy:** Field team can now detect and alert on this particle class
4. **Share:** Export dataset to other Edge units or central lab for team-wide detection
5. **Refine:** Laboratory performs formal classification with accumulated field data

Technology Foundation

APID is built on industry-standard, open-source technologies ensuring long-term maintainability and integration flexibility. The system leverages the **NVIDIA JetPack SDK** for GPU-accelerated inference, **Ultralytics YOLOv8** neural network architecture for object detection, and standard web technologies for the browser-based interface. Computer vision inputs comply with **USB Video Class (UVC)**, **ONVIF/RTSP**, and **GigE Vision** standards. BioNAV's patent-pending innovations reside in the detection methodology, training workflow, and system integration—not in proprietary dependencies.

Session Reporting & Documentation

Comprehensive reports document field activity for QC review and scientific provenance:

- Detection Summary: Total detections, confidence statistics, class distribution
- CV Systems Used: All input sources with resolution, timestamps, and source metadata
- Dataset Library: Loaded datasets with per-class performance metrics
- Training Model Activity: Recordings created, training runs, frames captured, QC recommendations
- PDF export for documentation, compliance, and laboratory handoff

Connectivity & Integration

- Standalone operation: No cloud dependency required for detection or training
- Network ready: Ethernet/WiFi for dataset sync when connectivity available
- Satellite compatible: Transmit classifications or receive dataset updates via satellite link
- Enterprise scalable: Edge-to-cloud architecture for organization-wide deployment

Licensing & Services

BioNAV's APID process is licensed exclusively by BioNAV LLC. Additional services available:

- Technical consulting for CV system specification and selection
- System integration firm referrals for enterprise deployment
- OEM licensing for product integration
- Custom development partnerships

Contact

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Patents: PCT/US2024/031776 | WO2024249697

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