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AI-Driven Hyperspectral Imaging for Non-Invasive Biomedical Diagnostics

- Real-time tissue characterization bridging the gap between raw data and clinical insight.
- AI + Hyperspectral Imaging + Digital Health Interoperability
- Scalable, India-first medical innovation designed for diverse populations.

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The Problem

EARLY DISEASE DETECTION LACKS BIOCHEMICAL INSIGHT

- Conventional imaging (RGB, MRI, endoscopy)
- Misses early molecular & metabolic changes
- Biochemical markers (oxygenation, chromophores, perfusion) remain invisible
- Results in delayed diagnosis & poor clinical outcomes

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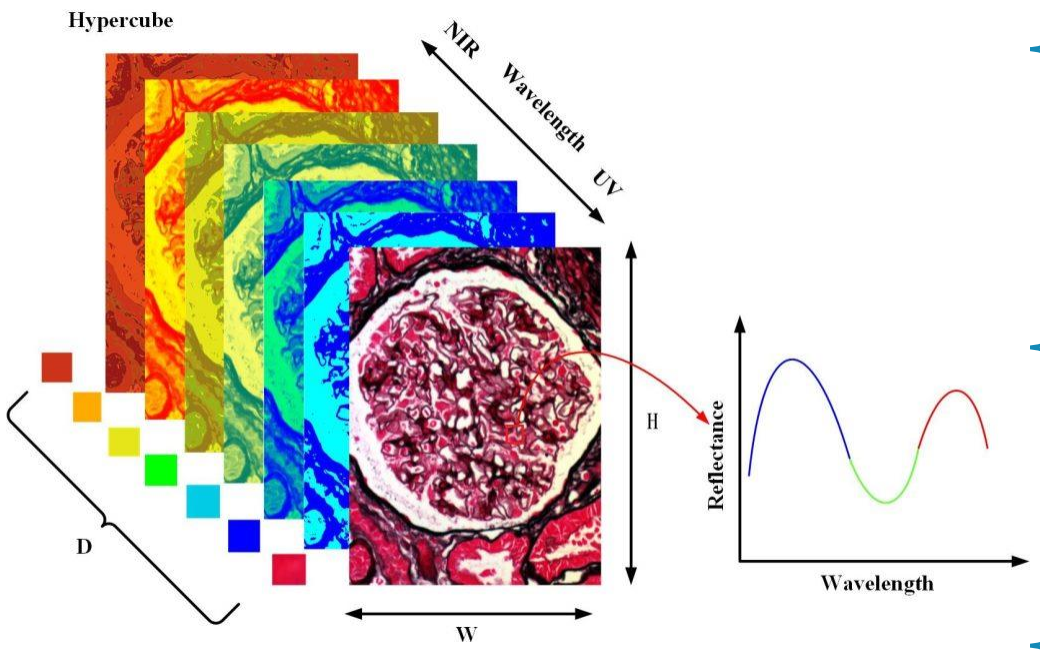
Why Existing Solutions Fail

THE CLINICAL TRANSLATION GAP

- Hyperspectral Imaging (HSI) exists mostly in labs
- No standardized spectral data formats
- Poor model validation & explainability
- High latency → not usable in real time
- Population-specific bias (e.g., skin tone variability in India)

Opportunity

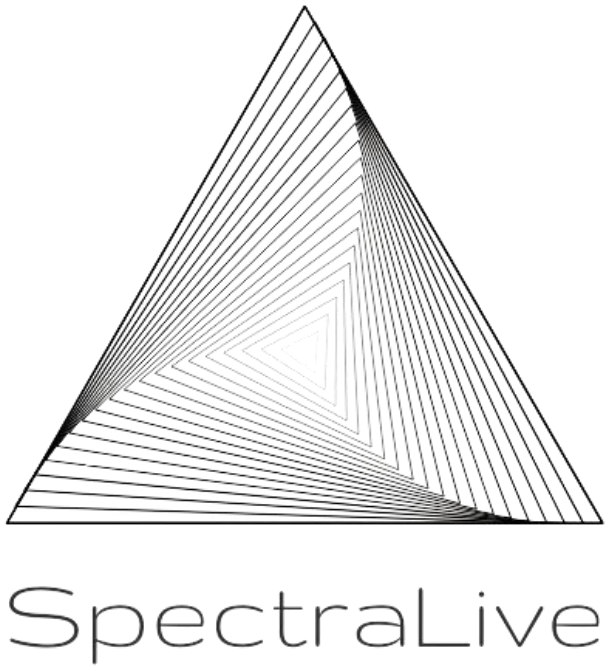
HYPERSPECTRAL IMAGING + AI



- HSI captures rich spectral “fingerprints” of tissue
- Enables detection of:
  - Hemoglobin, melanin, water content
  - Oxygen saturation (StO_2)
  - Early pathological changes
- AI can transform raw hypercubes into actionable diagnostics

Our Solution

AN AI-DRIVEN, END-TO-END COMPUTATIONAL IMAGING FRAMEWORK THAT ENABLES:



- Standardized hyperspectral data acquisition
- Population-aware AI models
- Real-time, edge-deployable inference
- Seamless clinical & digital health integration

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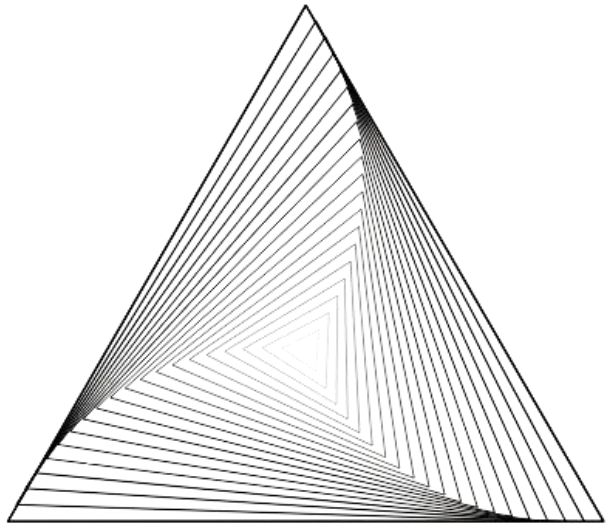
Core Innovation

WHAT MAKES SPECTRALIVE DIFFERENT

- Standardized Data Warehouse
- Population-specific spectral libraries (India-centric)
- Explainable AI for clinician trust
- Clinically easy to operate
- Emmens Research opportunity



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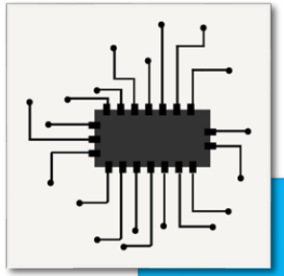
Technical Architecture

HARDWARE–SOFTWARE CO-DESIGN



Hardware

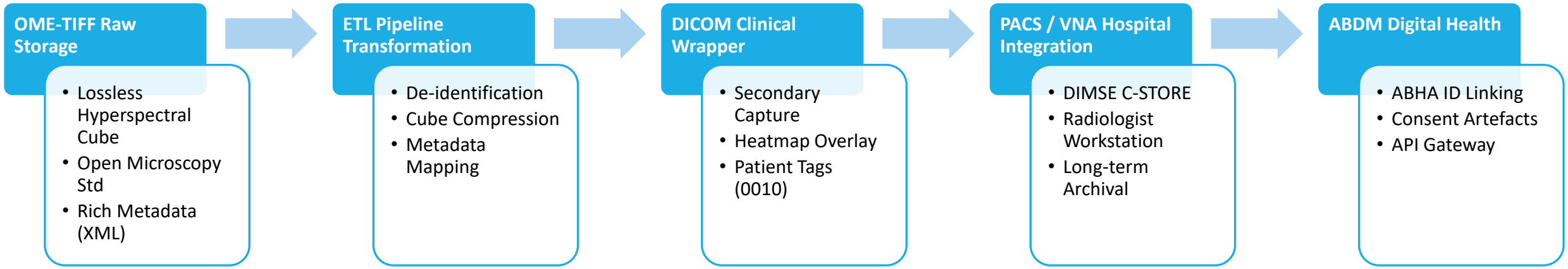
- VNIR hyperspectral cameras (Specim, Cubert)
- Edge inference (Jetson / Edge TPU)

Software

- Python | C++ acquisition stack
- PyTorch / TensorFlow models
- Multithreaded, zero-copy pipelines

Data & Interoperability

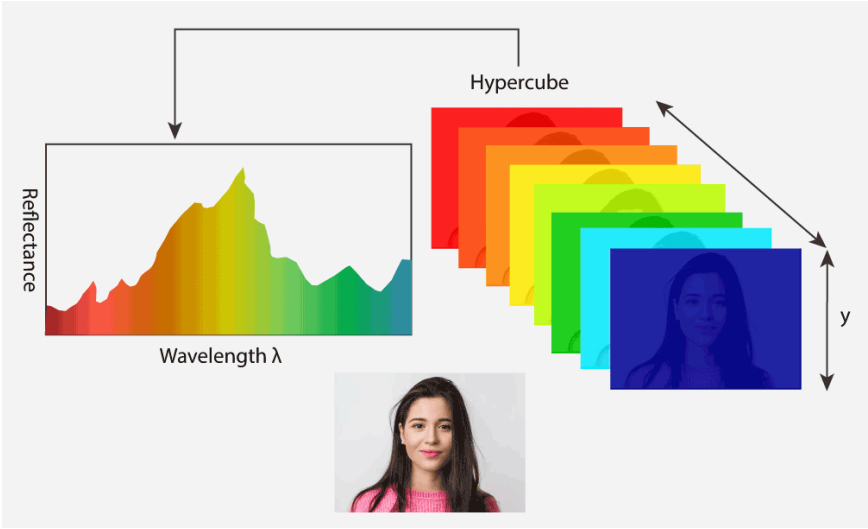
BUILT FOR REAL HOSPITALS, NOT JUST LABS



AI & ML Stack

ADVANCED, RESPONSIBLE AI

- 3D-CNNs → spatial-spectral learning
- Vision Transformers → long-range spectral dependencies
- Bias mitigation via stratified training (skin tone aware)
- Explainability using Grad-CAM & SHAP



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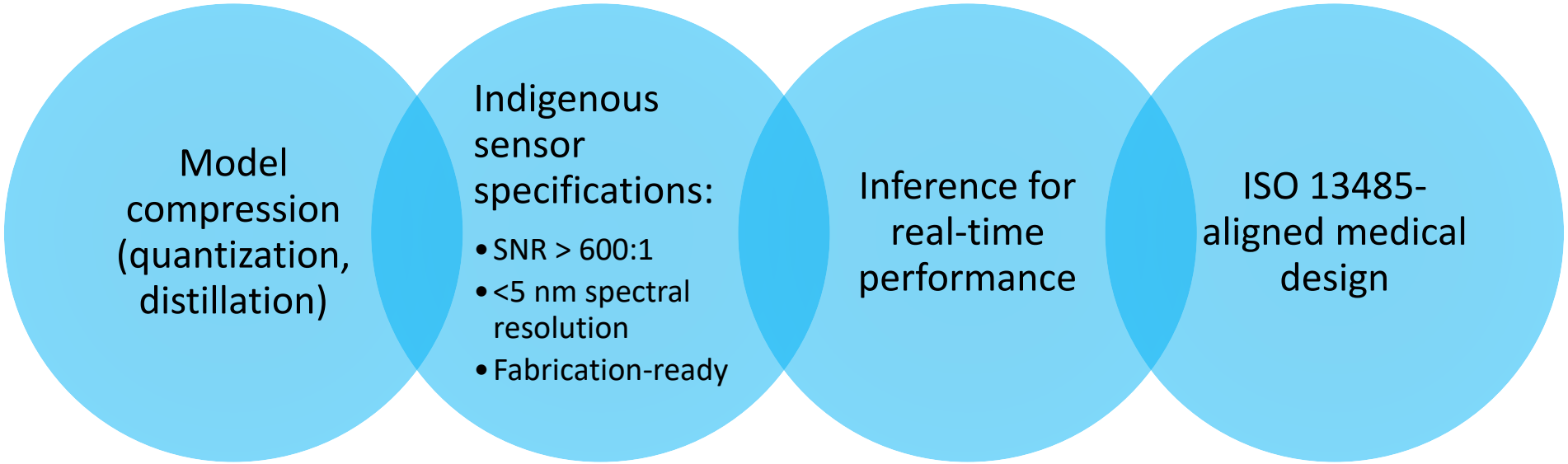
Edge & Indigenous Focus

DESIGNED FOR DEPLOYMENT AT SCALE



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Privacy & Trust

HEALTHCARE-GRADE SECURITY

- AES-256 encryption at rest
- TLS 1.3 for data in transit
- Automated anonymization
- Federated Learning:
  - No patient data leaves hospitals
  - Only model updates are shared

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Use Cases

HIGH-IMPACT CLINICAL APPLICATIONS

- Early cancer detection (oral, head & neck)
- Diabetic Foot Ulcer (DFU) monitoring
- Surgical guidance & margin assessment
- Resource-limited & rural healthcare settings
- Research & clinical trials

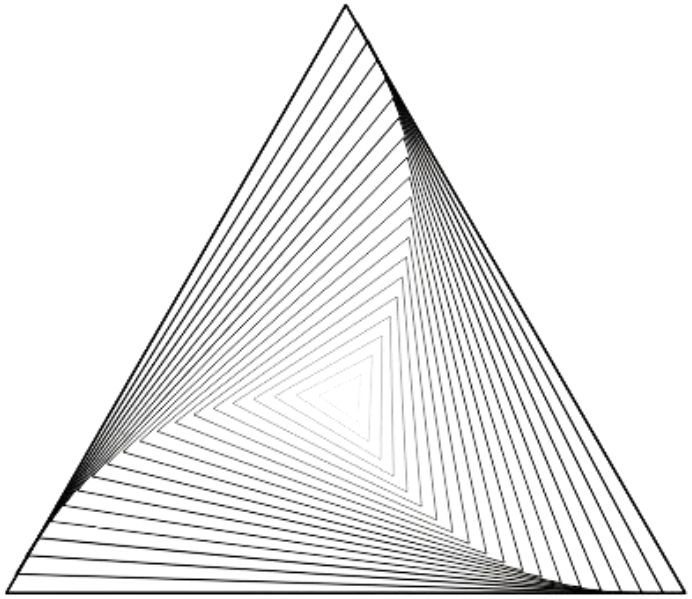
OTHER APPLICATIONS

- Defence equipment spectral signature matching
- Agriculture crop disease detection and classification
- Mineral exploration
- And many more

Expected Outcomes

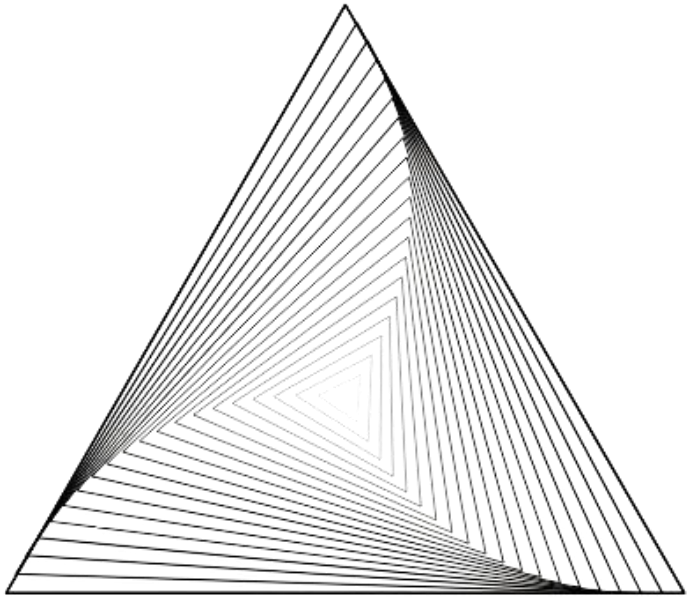
WHAT SPECTRALIVE DELIVERS

- Open, population-specific spectral library
- Deployable AI models for edge devices
- Modular open-source HSI software suite
- Reference architecture for indigenous medical devices
- Strong IP & commercialization potential



Impact

WHY SPECTRALIVE MATTERS



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- Bridges lab research → bedside diagnostics
- Reduces dependency on imported medical systems
- Supports Make in India & Digital Health missions
- Improves early diagnosis & patient outcomes
- Positions India as a leader in AI-enabled medical imaging

Thankyou