Fire Visual Intelligence for Wildfire Surveillance and Early Warning (FireVIZ)

Dr. Pikul Vejjanugraha

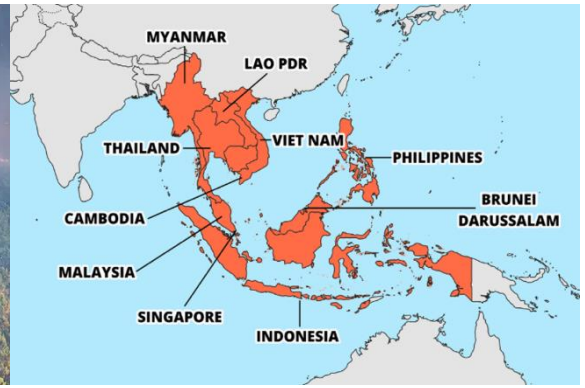
College of Arts, Media and Technology
Chiang Mai University, Thailand



Background

- Wildfires, forest fires and biomass burning recur every dry season across Southeast Asia, damaging forest ecosystems, local communities, air quality and public health.
- **Smoke and haze cross national borders** — ASEAN responded with the ASEAN Agreement on Transboundary Haze Pollution (AATHP).
- **Southeast Asia**: large forest areas, mountainous terrain, limited accessibility and uneven monitoring infrastructure make continuous surveillance difficult.





Existing tools:

Satellites (Himawari, NASA fire products)

+ Wide-area coverage & historical hotspots
– No continuous local visual confirmation of early-stage fires

Fixed / PTZ cameras

+ Continuous AI smoke & flame detection
– Limited by field of view, terrain and vegetation

PM2.5 & weather stations

+ Environmental conditions & air-quality impact
– Indirect; cannot locate the fire itself

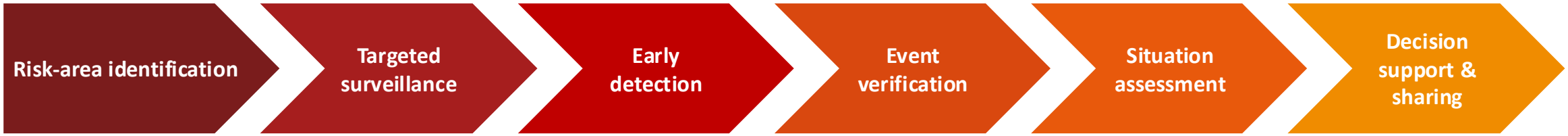
UAVs

+ On-demand investigation beyond camera coverage
– Not continuous; deployed only when needed

One risk-informed system that links wide-area observation with targeted, continuous local surveillance.

FireVIZ — Targets

Target: an integrated wildfire surveillance and early-warning framework.



1-2 Identify risk areas

Prioritize wildfire-prone and recurrent fire areas using historical fire records, satellite, spatial and environmental data.

3 Detect early

AI-driven Visual IoT with fixed and PTZ cameras for day-and-night smoke and fire detection and early warning.

4-5 Verify & assess

Integrate satellite, UAV, PM2.5, meteorological and camera data for event verification and situation assessment.

6 Support decisions

FireVIZ platform for spatiotemporal visualization, event management, alerts, historical analysis and decision support.

7 Share regionally

Standardized wildfire event inventory and information sharing, validated through field deployment and technology transfer.

Pilot countries : Thailand · Lao PDR · Vietnam · Myanmar · Cambodia and ***plan to*** expandable to **other ASEAN Member States**

Proposed Method: Integrated Framework

Scientific & technological approach:

- **Risk mapping:** historical satellite hotspots and fire records guide where cameras are deployed
- **AI Visual IoT:** day-and-night smoke & fire detection, localization and tracking (visible & thermal, fixed + PTZ)
- **Multi-source fusion:** satellite, UAV, PM2.5 and meteorological data verify and characterize each event
- **Event model:** standardized spatiotemporal wildfire event records



*"It is an event-oriented, **multi-source framework** that connects satellite risk information, real-time visual detection, optional UAV verification, environmental observations and regional event sharing in a single operational workflow."*

Proposed Method: Integrated Framework

FireVIZ platform:

Edge AI Processing: AI inference is performed directly on cameras or drones, transmitting only detection results instead of raw video streams.

Event-Driven Architecture: The event bus buffers incoming data, allowing the system to handle thousands of cameras and sensors without becoming overloaded.

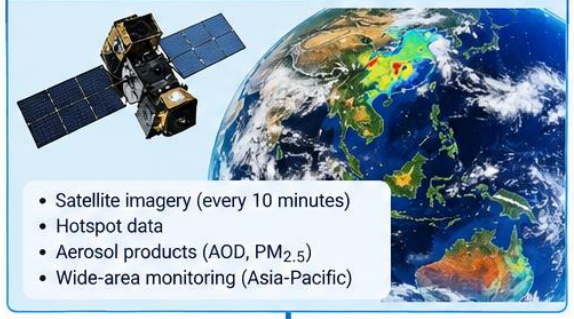
Scalable Database Architecture: Read replicas improve query performance, while data partitioning by country and time period supports efficient data management.

Federated Regional Architecture: Each country operates its own independent system while synchronizing relevant data with a centralized regional platform.



Proposed Method: System Architecture (Chiang Mai, Thailand)

Himawari Satellite
(NICT / JAXA)



- Satellite imagery (every 10 minutes)
- Hotspot data
- Aerosol products (AOD, $PM_{2.5}$)
- Wide-area monitoring (Asia-Pacific)

Visual IoT System
(NICT / NECTEC)



- Fixed/PTZ cameras
- Infrared and thermal imagery
- AI-based smoke and fire detection
- Satellite hotspot info can guide PTZ control

N-gate Environmental Station
(NECTEC)



- $PM_{2.5}$ concentration
- Temperature
- Humidity
- Rainfall
- Atmospheric pressure
- Wind speed
- Multiple sensor interfaces
- IEC standard compliance
- Low power, suitable for remote areas

Multi-source Data

AI/ML & Data Processing
(NECTEC)



- Smoke/fire detection models
- $PM_{2.5}$ prediction model
- Data processing pipelines
- Technical interfaces (APIs)

Data Fusion & System Integration
(NECTEC + CMU)



- Integrate heterogeneous data
- Detect and localize smoke/fire events
- Generate real-time alerts
- Provide environmental assessment

Integrated Web Platform
(CMU – NEXT Lab)



- Web-based application
- Visualization (maps, events, $PM_{2.5}$)
- Alert management
- Real-time notifications
- Reporting
- User management
- Scalable and extensible design

Users and Stakeholders

- **Local Authorities** (e.g., DPM, provincial offices)
- **National Park Authorities**
- **Field Officers** (rangers, local staff)
- **Communities**

→
- Monitor environmental conditions
- Verify detected events
- Receive timely alerts
- Support evidence-based decision making

Expected Impacts

- Reduce the number of hotspots
- Reduce the number of days with excessive $PM_{2.5}$ concentrations
- Lower annual average $PM_{2.5}$ levels
- Support transboundary haze mitigation and sustainable environmental management in the Mekong region

FireSpot & Smoke Detection in Chiang Mai







Proposed Method: Work Packages & Field Testing

DETECTION & PLANNING

WP1
Risk-Area Identification & Surveillance Planning

Find recurrent wildfire-prone areas from satellite hotspots and fire records; choose camera sites.

WP2
Visual IoT Wildfire Surveillance

Fixed & PTZ cameras with AI smoke/fire detection, localization, tracking and early alerts.

VERIFICATION & ASSESSMENT

WP3
UAV-Based Event Investigation

Optional on-demand UAVs to verify events, cover blind spots and assess fire extent.

WP4
Environmental Impact & Situation Assessment

Combine PM2.5, weather, satellite and fire-event data to assess air-quality impact.

PLATFORM, SHARING, and DEPLOYMENT

WP5
FireVIZ Integrated Intelligence Platform

Spatiotemporal platform for visualization, event management, alerts and decision support.

WP6
Regional Event Inventory & Information Sharing

Standardized wildfire event records for cross-border awareness and historical analysis.

WP7
Pilot Deployment, Evaluation & Technology Transfer

Field validation, stakeholder training and technology transfer in many countries.

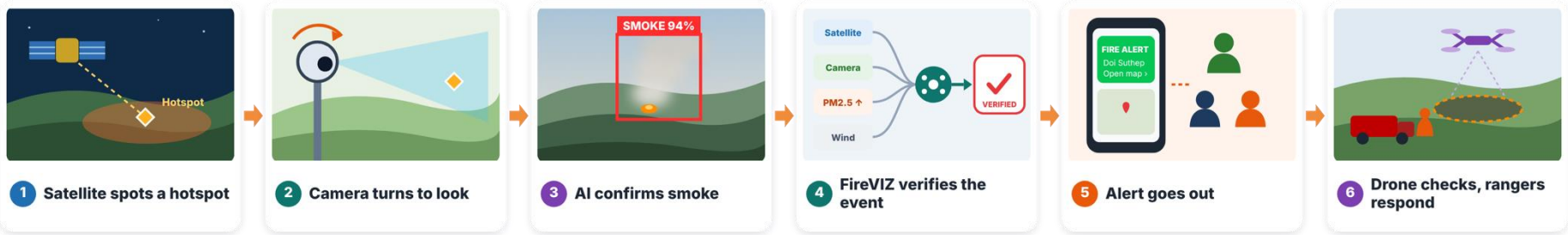
Field Testing

Pilot sites in wildfire-prone areas of **ASEAN countries**, building on existing Chiang Mai Visual IoT.

Each country keeps its own monitoring infrastructure and shares selected wildfire event data through a common, standardized event-data structure.

Impact: Scientific & Technological

From scattered sensors to one intelligent, risk-informed wildfire system



1 Risk-informed surveillance

Smart siting

satellite risk → camera placement

~~Blanket, ad-hoc monitoring~~
→ **Cameras where fires recur**

Historical hotspots rank wildfire-prone areas, so every camera covers the highest risk.

2 Day-and-night AI detection

24/7

visible + thermal AI

~~Daytime-only smoke detection~~
→ **Smoke & flame, day and night**

Detect, localize and ***track early fires;*** PTZ cameras steered by satellite hotspots.

3 Multi-source event fusion

5 → 1

data sources → one verified event

~~Separate, unlinked data feeds~~
→ **One verified event, full context**

Satellite, camera, UAV, PM2.5 and weather confirm each fire to ***reduce false alarms***.

4 Event-oriented data model

1 standard

shared by ASEAN countries

~~Incompatible national records~~
→ **Comparable regional inventory**

Enables cross-border analysis, open research datasets and AI benchmarking.

Impact: Societal & Collaborative

Protecting people, forests and air — together across ASEAN

SOCIETAL

Fewer hotspots
Earlier detection and faster response.

Cleaner air
Fewer days of excessive PM2.5.

FireVIZ

Healthier lives
Lower annual average PM2.5 levels.

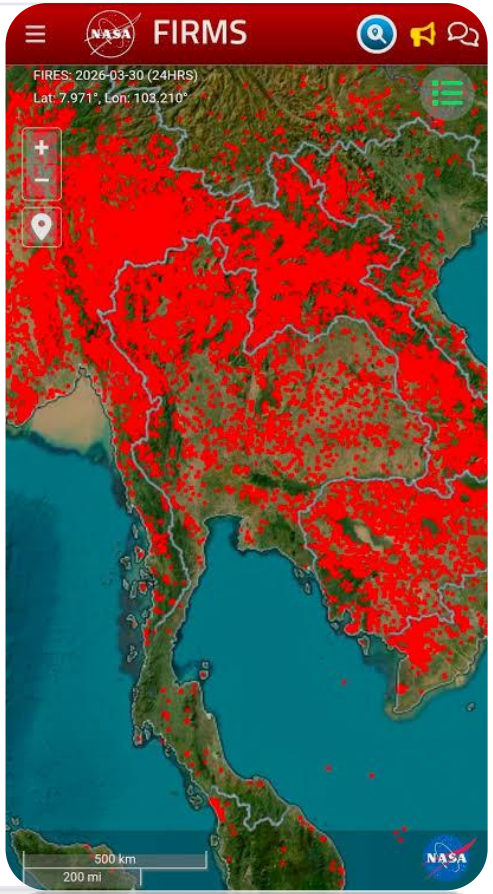
Less haze
Transboundary haze mitigation in the Mekong region.

COLLABORATIVE

shared event standard

JP	**NICT** Visual IoT
TH	**NECTEC** AI/ML · Visual IoT · N-gate stations
TH	**Chiang Mai University** FireVIZ platform · UAVs · data fusion
+ ASEAN	**Partner countries** Pilot sites · local data · field deployment

Builds on: NECTEC–NICT Visual IoT Network · CMU UAV surveillance (Pilot study)



Earlier warnings for people • Shared knowledge across borders • A regional network that can grow to all ASEAN

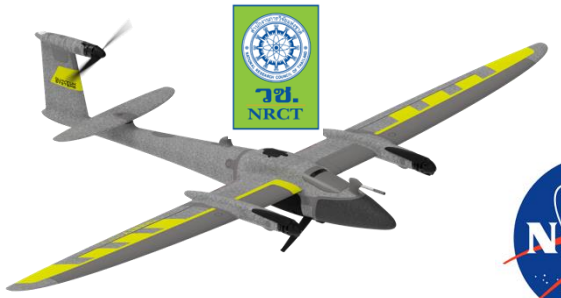
Output/Outcome: Key Deliverables

Tangible deliverables — technology, data and people

SCIENTIFIC

1. **FireVIZ platform**
   Web GIS + mobile app with real-time alerts
2. **AI models**
   Day & night smoke/fire detection, tracking; PM2.5 prediction
3. **Wildfire risk maps**
   Prone-area maps + camera-siting method
4. **Fusion pipeline & APIs**
   Multi-source data → verified events







Live Map
Wildfire events, hotspots, cameras, LIV coverage, PM2.5 and risk zones

Data Layers
Satelllite, VIIRS, IoT (FS&IR), LIV, PM2.5 and meteorological data

Alerts & Notifications
Real-time fire and smoke alerts (web, mobile and LINE)

Event Management
Track and verify events from detection to closure
Create → In Progress → Closed

Dashboards & Analysis
Fire trends, PM2.5 impact, weather and situation overview

Users, APIs & Integration
Role-based access, data sharing and integration with partner systems
API

Output/Outcome: Key Deliverables

Tangible deliverables — technology, data and people

"FireVIZ empowers authorities and communities to respond faster to wildfires through early warnings and actionable intelligence."



SOCIETAL

1. **Smoke/fire image dataset**
   Expanded early-stage dataset shared for research
2. **Real-time alert service**
   Web & LINE alerts for authorities and communities
3. **Decision support**
   Reports for haze and PM2.5 management
4. **Technology transfer**
   Training and deployment know-how for local teams

COLLABORATIVE

1. **Regional event inventory**
   Standardized wildfire event-data structure
2. **ASEAN IVO network**
   Many countries working on one framework
3. **New partners**
   Lao PDR, Vietnam, Myanmar, Cambodia, and all ASEAN countries
4. **Joint field sites & research**
   Comparative evaluation, joint publications

It supports better decision-making to reduce wildfire impacts, PM2.5 pollution, and transboundary haze.

Conclusion: FireVIZ in Summary

Targets Detect wildfires earlier; faster, evidence-based response in 5 countries

Method Satellite risk maps + AI cameras + UAV/PM2.5 verification in one platform

Impact Fewer hotspots and high-PM2.5 days; shared regional event inventory

	UPSTREAM Data & technology	MIDSTREAM Platform & integration	DOWNSTREAM Users & society
SHORT-TERM Outputs	• Wildfire-prone area maps • AI cameras at pilot sites • Day & night smoke/fire AI models	• FireVIZ Web GIS platform • Data fusion & event verification • Standard event-data structure	• Real-time alerts to rangers & villages • Trained local teams • Faster verified response at pilots
LONG-TERM Outcomes	• Open smoke/fire dataset & benchmarks • Self-improving AI models • Sensor network expanded in ASEAN	• Regional wildfire event inventory • Interoperable national systems (APIs) • Service run by local agencies	• **Fewer hotspots & high-PM2.5 days** • **Less transboundary haze** • **Evidence-based haze policy (AATHP)**

New AI and data-fusion methods, fewer hotspots and high-PM2.5 days, and a shared regional wildfire event inventory.

FireVIZ

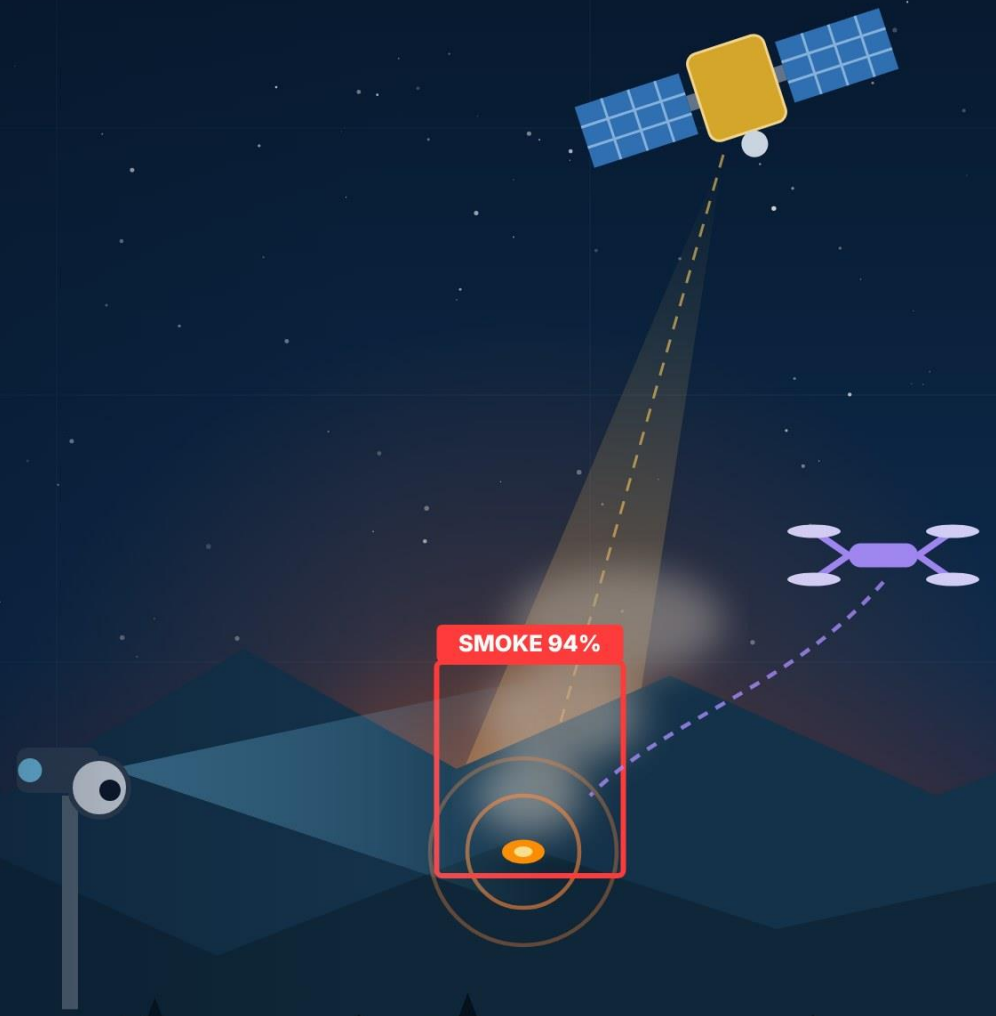
Fire Visual Intelligence for Wildfire Surveillance and Early Warning

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Thank you

Terima kasih · ขอบคุณค่ะ

From Space to the Ground, Toward a Cleaner and Safer ASEAN



Dr. Pikul Vejjanugraha

College of Arts, Media and Technology, Chiang Mai University, Thailand

Questions & collaboration welcome

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