ASPires

Advanced Systems for Prevention & Early Detection of Forest Fires

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Advanced systems for prevention and early detection of forest fires

Advanced Systems for Prevention & Early Detection of Forest Fires (ASPires)

Advanced Open IoT Platform for Prevention and Early Detection of Forest Fires

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AGENDA

- Objectives
- Platform Benefits
- Platform Overview
- State of the Art
- Demo

Advanced systems for prevention and early detection of forest fires

Objectives

- **Open and interoperable**
  - Wide range of interfaces, protocols and devices
  - Existing Crisis Management Systems (National, EU-level)
- **Continuous monitoring** of disaster related data
  - Retrospective disaster assessment
- **New methods** for fire detection (AI, drones, sensors)
- **Command devices** in surrounding area (i.e. barriers)
- **Automatic** processing and alert generation
- **Decision making** support
- **Cost efficient** monitoring

Platform Benefits

- Open source and free license components
- Deployment on-premises and public cloud
- Adaptable – multiple abstraction points
- Cutting edge technologies
  - AI, Machine Learning, Time Series data, Drones support
- High performance
  - 30’000+ connections, 7’000 req/second, 10M sensor parameters
- Built with security in mind
- TRL 6 (test in relevant environment)

The cloud platform aims to **combine the best approaches** to achieve **10% better fire assessment and prevention**.

European Commission | Horizon 2020 European Union funding for Research & Innovation

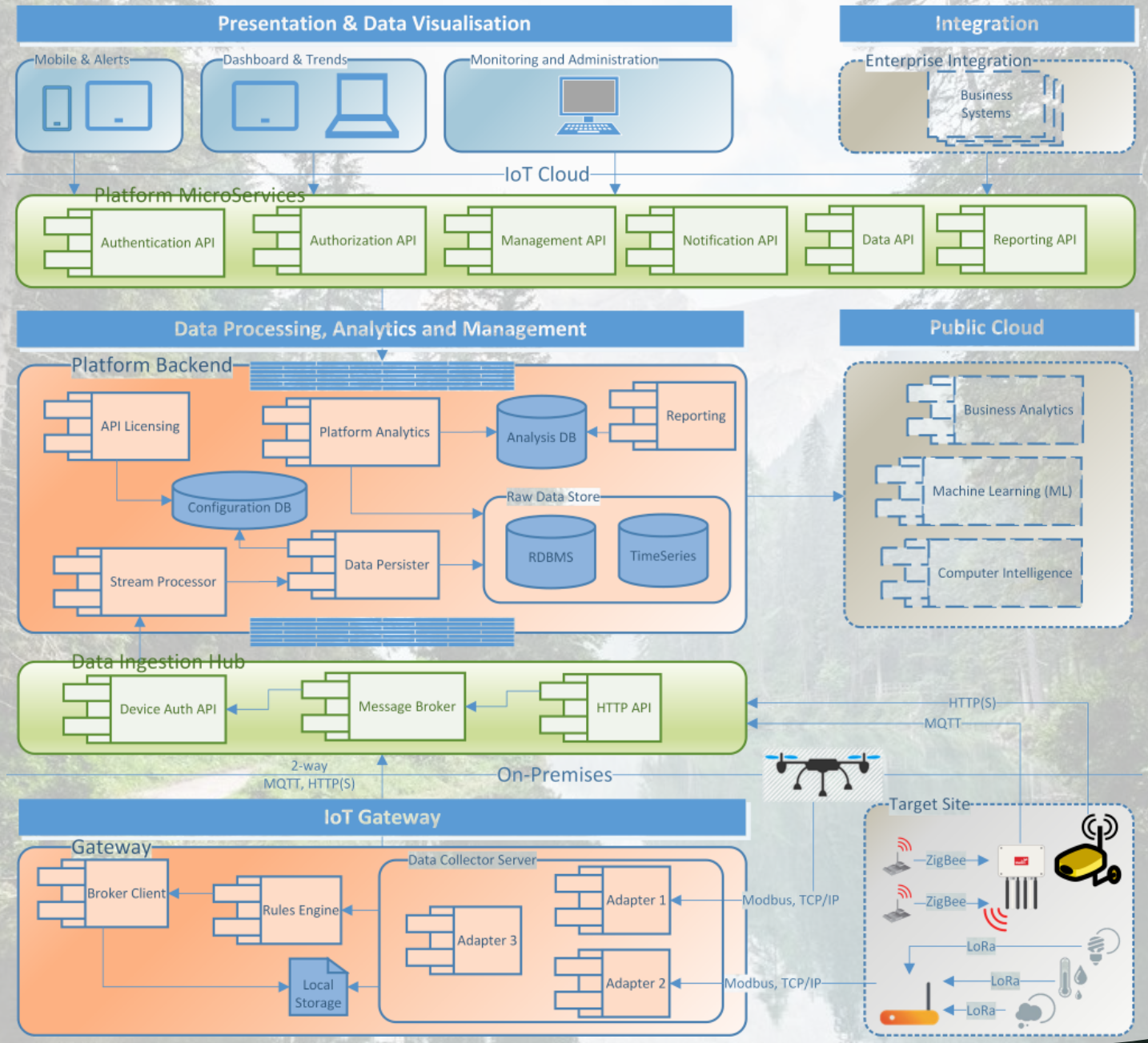
ASPires

Distributed & Open IoT Platform

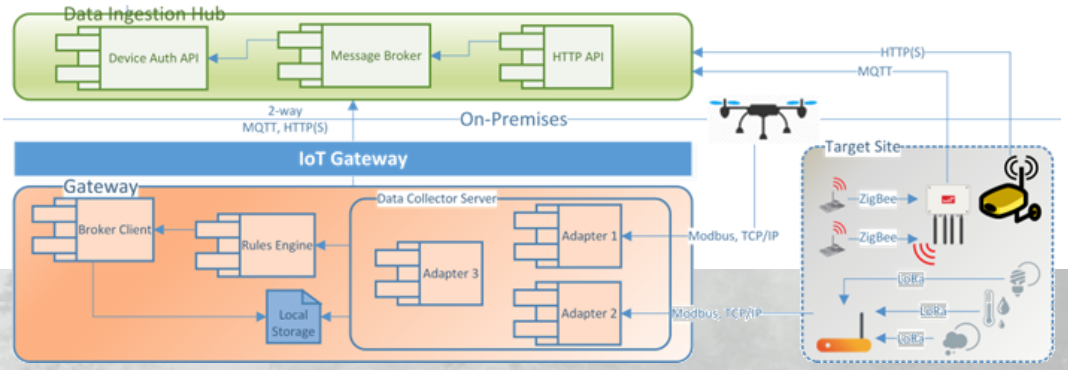
Funded by

EUROPEAN CIVIL PROTECTION AND HUMANITARIAN AID OPERATIONS

ECHO/SUB/742906/PREV03 (ASPIRES)



Ingestion Scope



Field gateway (On-premises)

- Local **aggregation point** for range of sensors (on-site, drone mounted)
- Features: Device specific protocol conversion (i.e. Lora-Modbus TCP)

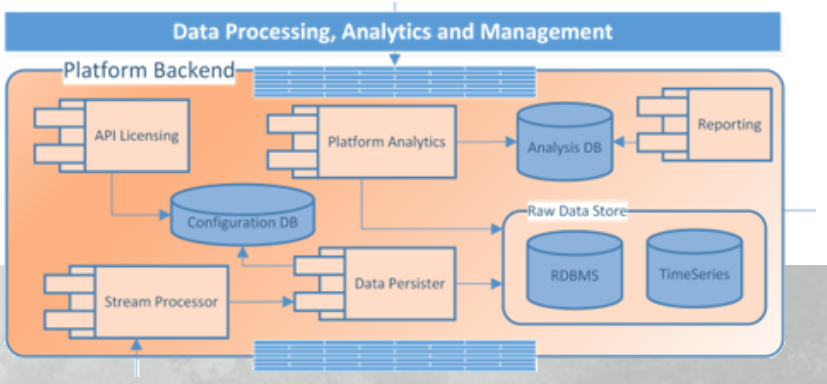
Cloud gateway (On-premises)

- Cross-platform SW gateway based on **Azure IoT Edge** with 2-way communication
- Features: Buffering, Processing, Protocol adapters (i.e. Profinet, Profibus, OPC, ZigBee…)

Ingestion Hub

- **Entry point** of the cloud platform (MQTT broker)
- Features: Secure 2-way communication over MQTT and HTTP

Cloud Scope



Stream Processor

- **Real-time** data simple **analytics** (i.e. threshold, anomaly detection, data conversion)
- Features: Streaming data examination and processing

Data Persisters

- Data **storage engine abstraction** (RDBMS, Time Series)
- Features: Read/Write operations on persistence storage

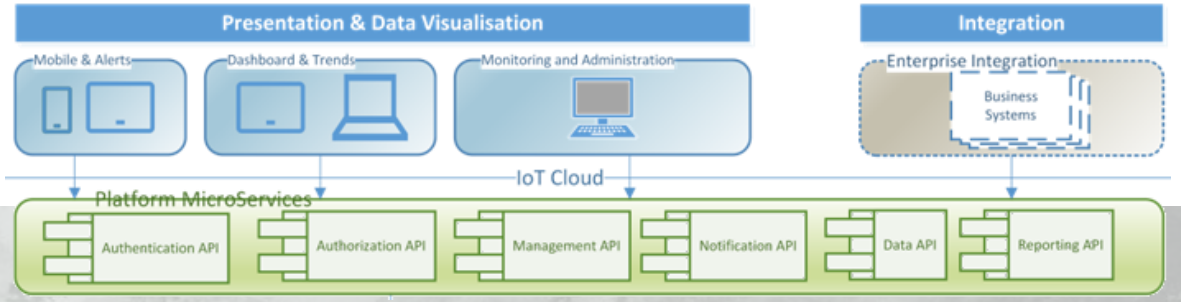
Data Storage

- Asset **Configuration**, Raw Data, **Time Series Data**
- Features: Performance (40x-60x faster than SQL and NoSQL) and TS data functions

Analyzer Services

- Generic and specific **pluggable custom logic** components
- Features: Asynchronous data processing

Consumer Scope



Micro-Services

- Open format scalable APIs (GraphQL)
- Features: Identity Management, Data Retrieval & Manipulation, Alerts

Configuration Portal

- Administrative Web UI
- Features: Platform configuration and asset management (i.e. GW, sensors, users)

Visualization

- 3rd Party Applications (Mobile, Web, Hybrid)
- Features: Responsive, administration, dashboarding

3rd Party Integration

- Crisis Management Systems, Resource Management
- Features: Raw data, trends, analytics and alerts visualization

State of the Art

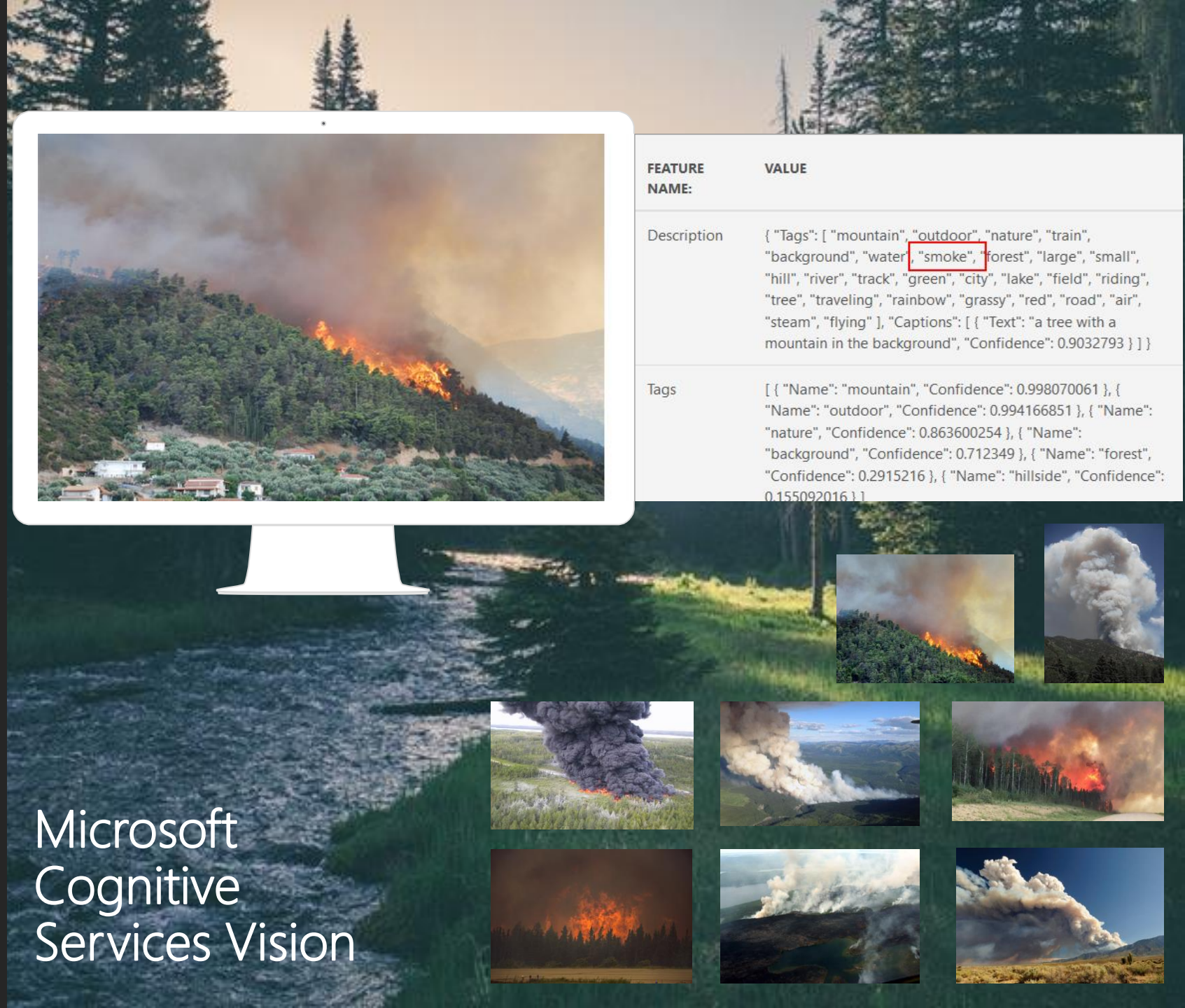
Drone Support

- Complement infrastructure (i.e towers)
- Rapid deployment almost anywhere
- Sensor data collection (fixed, mobile)
- Visual image and thermography
- Near real-time transmission
- Low cost

Computer Intelligence

- Seas of data are generated by sensors
  - How to gain insight on **hidden relations**?
  - How to get **actionable results**?
  - How to make platform provide **business value**?
- Open issues
  - **Cameras are diagnostic** and not predictive approach
  - Thermal cameras cannot detect **fire behind hills**
  - FWI is not able to **model hidden relations** and thresholds
  - **Human operators** are required

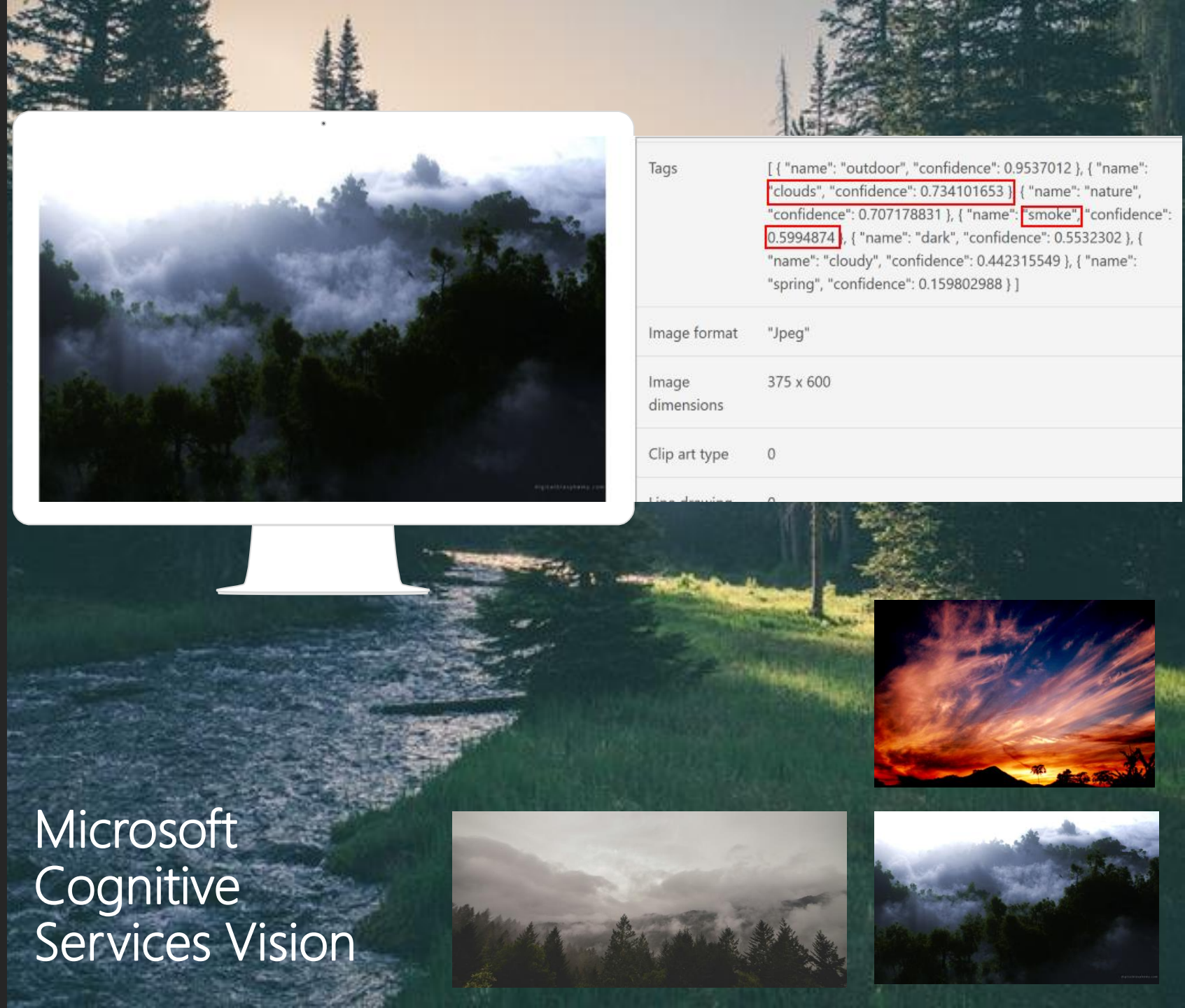
- Computer intelligence and computer vision could be used for automated alerting
- Works on predefined description tags
- Less operators could cover larger area



FEATURE NAME:	VALUE
Description	{ "Tags": ["mountain", "outdoor", "nature", "train", "background", "water", "smoke", "forest", "large", "small", "hill", "river", "track", "green", "city", "lake", "field", "riding", "tree", "traveling", "rainbow", "grassy", "red", "road", "air", "steam", "flying"], "Captions": [{ "Text": "a tree with a mountain in the background", "Confidence": 0.9032793 }] }
Tags	[{ "Name": "mountain", "Confidence": 0.998070061 }, { "Name": "outdoor", "Confidence": 0.994166851 }, { "Name": "nature", "Confidence": 0.863600254 }, { "Name": "background", "Confidence": 0.712349 }, { "Name": "forest", "Confidence": 0.2915216 }, { "Name": "hillside", "Confidence": 0.155092016 }]

Microsoft Cognitive Services Vision

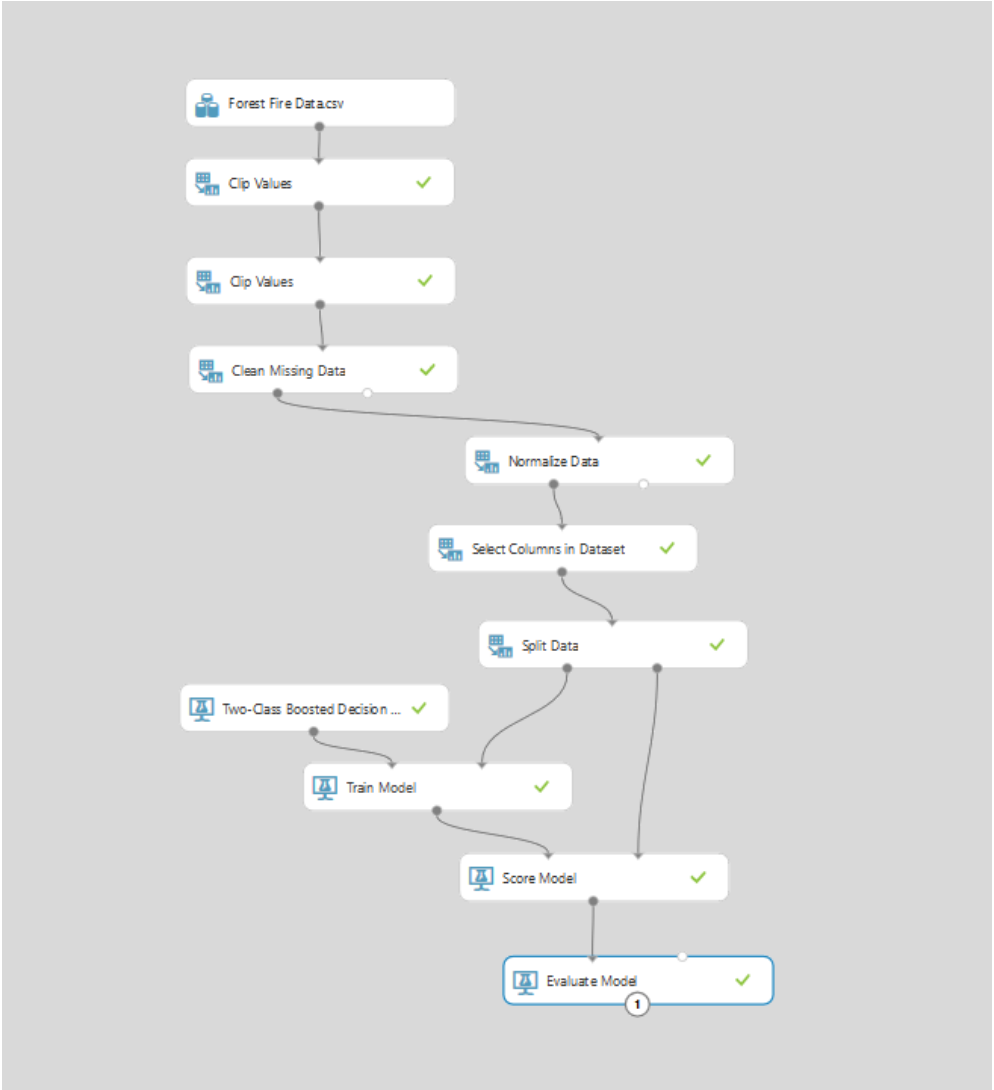
- Computer vision can process **low resolution images** (VGA)
- Capable to **distinguish clouds from smoke**
- **Alerts** are raised based on **confidence level**



Machine Learning

- Predict fire state with certain **confidence level**
- **Predictive features** identified by analysis of processes in crisis management systems
- Model consumed as **cloud web service**

(ML Studio & Azure Model Management Service)



Platform Openness

- Open source technologies
  - Microsoft Azure IoT Edge
  - Influx DB
  - Mosquitto MQTT
  - IdentityServer4
- Open protocols
- Inbound & Outbound Interfaces
- Data & Alerts Services
- CMS Systems: EFFIS, MKFFIS

Sensors Map
Frame counter
18951
Radio Frequency
868.1 Hz
RSSI
-120 dBm
Spreading Factor
12
Lora Signal to Noise Ratio
-0.5 dB
Lora Signal to Noise Ratio
Lora Signal to Noise Ratio (Live)
Last 2 hours
RH
34%
RH
RH (Live)
Last 2 hours
CO2
691 ppm
CO2
CO2 (Live)
Last 2 hours
DEMO