FIRE AND SMOKE DETECTION MODEL

Project Documentation

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DEPI

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2. PROJECT PROPOSAL

Overview:

The **Smoking and Fire Detection System** aims to develop a deep learning-based solution for identifying smoking activities and fire hazards from images. The project will leverage **image classification** and **object detection** techniques using **TensorFlow, Keras, and PyTorch** while utilizing **Azure** for cloud-based deployment and real-time monitoring.

Objectives:

- Develop an **accurate image classification model** to detect smoking and fire hazards.

- Build an **efficient object detection model** to identify cigarettes, smoke, and flames in images.

- Deploy the models on the **cloud** for real-time predictions.

- Develop a **web-based interface** for easy user interaction and alert notifications.

- Implement **MLOps practices** for continuous monitoring, logging, and improvement.

Scope:

1. **Data Collection & Preprocessing**

   o Gather diverse datasets containing images of smoking, fire, and safe environments.

   o Apply image augmentation and preprocessing techniques to improve model robustness.

2. **Model Development**

   o Train and fine-tune deep learning models for classification and detection.

   o Evaluate model performance using accuracy, precision, recall, and F1-score.

3. **Cloud Deployment & Real-Time Inference**

   o Deploy models on **Azure** for real-time detection.

   o Implement APIs for seamless integration with external applications.

4. **User Interface Development**

   o Design a **web-based dashboard** for users to upload images and receive predictions.

   o Integrate alert systems (email/SMS) for detected fire or smoking activities.

5. **Monitoring & Optimization**

   o Implement **logging and analytics** for performance tracking.

   o Continuously refine models based on new data and feedback.

3.1 FUNCTIONAL REQUIREMENTS

1. Fire and Smoke Detection

- The system must accurately detect fire and smoke in images and videos using AI models such as **YOLO** or other deep learning-based approaches.

- It should identify and highlight the affected areas using **bounding boxes** for better visualization.

2. Real-Time Alerts

- Upon detecting fire or smoke, the system must immediately send alerts via **email, SMS, or mobile app notifications**.

- It should support integration with **fire alarm systems and sprinkler systems** for an automated response.

3. Classification Accuracy

- The system must differentiate between **smoke, fog, and steam** to reduce false alarms.

- It should classify fire incidents based on type, such as **forest fires, house fires, or vehicle fires**, to aid in appropriate response measures.

4. Integration with Security Cameras

- The system must support **both thermal and regular cameras** for comprehensive monitoring.

- It should allow **multiple camera connections** and provide a **centralized monitoring platform** for real-time surveillance.

5. Reporting and Analytics

- The system should generate **detailed reports** on fire incidents, including **timestamps, locations, and severity levels**.

- It must offer **data analytics** capabilities to identify **high-risk areas and trends** over time.

3.2 NON-FUNCTIONAL REQUIREMENTS

1. Real-Time Processing

- The system must detect fire and dispatch alerts **within five seconds** to ensure timely intervention.

2. Accuracy and Precision

- The fire and smoke detection model must achieve at least **95% accuracy** to minimize false positives and false negatives.

3. Scalability

- The system must support **multiple camera feeds** and be capable of handling **a large number of users** concurrently.

- It should be **deployable on cloud servers, edge devices, or on-premise systems** to meet various operational needs.

4. Security and Data Protection

- The system must implement **robust cybersecurity measures** to prevent unauthorized access or tampering.

- All **stored and transmitted data** must be **encrypted** to ensure privacy and compliance with security standards.

5. Reliability and Availability

- The system must maintain **99.9% uptime** to ensure continuous operation and fire detection.

- It should incorporate a **backup system** to store incident data in case of **server failure**.

6. Interoperability

- The system must seamlessly integrate with **fire safety systems, IoT devices, and external APIs** for enhanced functionality.

- It should provide a **REST API** to allow third-party applications to access fire detection data and alerts.

7. Usability

- The **user interface** must be **intuitive and user-friendly**, enabling easy operation for both technical and non-technical users.