



**Vivekanand Education Society's**

**Institute of Technology**

(Affiliated to University of Mumbai, Approved by AICTE & Recognized by Govt. of Maharashtra)

**Department of Information Technology**

**IOE Lab**

**CONTINUOUS ASSESSMENT - 2**

Aim: Design of IOT application.

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Grade:	

## CA - Assignment 2

**AIM:** Design of IOT application.

### **TO-DO:**

- Identify the layer specific actions/responses/activities (for each layer - edge - fog - cloud)
- Identify the sensors/actuators required
- Identify the best suited protocols
- Select the architecture
- Identify the information needed to be sent at the higher level

### **THEORY:**

Designing an IoT application for a **Railway Surveillance System** involves various components and considerations to ensure effective monitoring, control, and management of the railway network.

### **Layer specific activities:**

#### **1. Edge**

- Real-time data collection from sensors and cameras.
- Basic data preprocessing and local filtering.
- Immediate response to detected events, such as sending alerts or activating local alarms.
- Initial categorization of events (normal, abnormal, critical) based on predefined rules.
- Capturing images or short video clips for later analysis.

#### **Information Exchange:**

- Event data, including timestamps and basic event categorization.
- Captured images or video snippets for further analysis.

#### **2. Fog**

- Aggregating data from multiple edge devices for a broader perspective.
- More advanced data preprocessing, including noise reduction and data fusion.
- Running local analytics and pattern recognition to identify more complex events.
- Intermediate decision-making based on more sophisticated rules or machine learning models.
- Generating summaries or reports of detected patterns and events.

#### **Information Exchange:**

- Aggregated event data, including refined categorization and pattern detection results.
- Summarized reports of events and patterns for further analysis.

### **3. Cloud**

- Storing and managing large-scale historical data for long-term analysis.
- Complex data analytics, including advanced machine learning algorithms for predictive maintenance and anomaly detection.
- Generating comprehensive reports and insights based on historical data and real-time inputs.
- Collaborative decision-making involving different stakeholders.
- Scaling up resources for processing during peak periods.

#### **Information Exchange:**

- Comprehensive analysis reports, including trends, anomalies, and predictions.
- Maintenance recommendations, insights for process optimization, and performance metrics.

#### **Sensors/actuators required:-**

##### **Sensors:-**

1. CCTV Cameras
2. Infrared Motion Sensors
3. Vibration Sensors
4. Door Sensors
5. Temperature Sensors
6. Pressure Sensors
7. Smoke and Fire Detectors
8. Gas Sensors
9. Speed Sensors
10. GPS Systems
11. Track Condition Sensors
12. Weather Sensors

##### **Actuators:-**

1. Signal Actuators
2. Barrier Actuators
3. Emergency Brake Actuators
4. Intercom Systems

## **Protocols :-**

### **Wireless Communication: LoRaWAN**

LoRaWAN (Long Range Wide Area Network) is a low-power, wide-area network protocol designed for long-range communication with low data rates. It's suitable for covering vast railway tracks and remote areas where traditional cellular networks might not be available. LoRaWAN's long battery life and extended coverage make it an ideal choice for IoT devices in railway surveillance.

### **Local Communication: Zigbee**

Zigbee is a low-power, short-range wireless protocol commonly used for home and industrial automation. It's suitable for connecting sensors and devices within a train compartment or a station, providing reliable and energy-efficient communication.

### **Data Storage and Transmission: HTTP/HTTPS**

For transmitting data to a central server or cloud platform, standard HTTP (Hypertext Transfer Protocol) or its secure counterpart HTTPS can be used. This allows for integration with web services, data storage, and real-time monitoring of railway surveillance data.

### **Data Exchange: RESTful APIs**

Representational State Transfer (REST) APIs are a simple and widely used method for data exchange between devices and servers. RESTful APIs use standard HTTP methods to send and receive data, making integration with other systems straightforward.

## **Architecture:-**

The best architecture for a railway surveillance system in IoT is a hybrid architecture that combines the benefits of both centralized and decentralized architectures. In this architecture, the sensors are connected to a local gateway, which then forwards the data to a central cloud server. The cloud server stores the data and performs complex analytics, such as video analytics. The local gateway can also perform some basic analytics, such as intrusion detection. This hybrid architecture provides the following benefits:

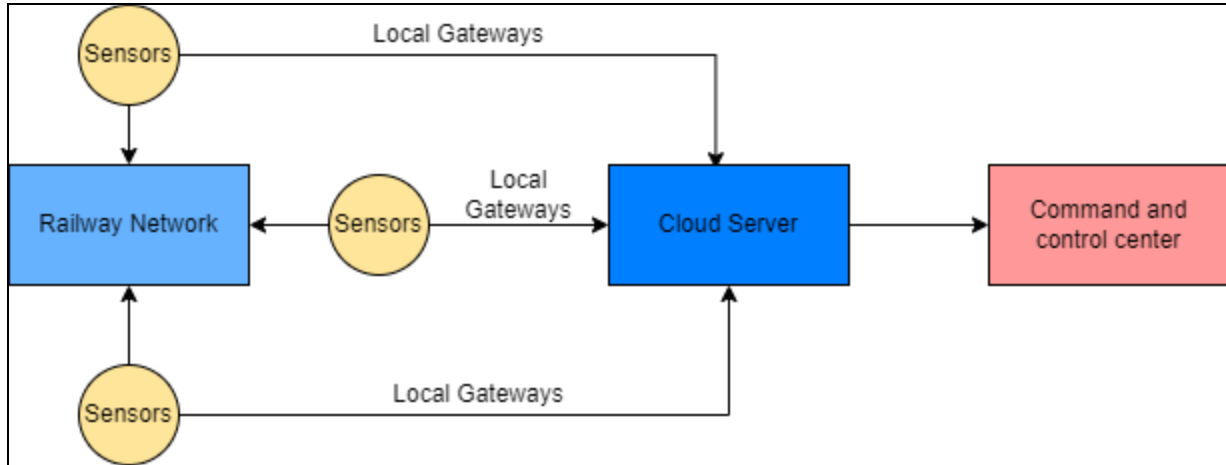
**Security:** The data is stored in the cloud, which is a more secure location than a local gateway.

**Scalability:** The system can be easily scaled by adding more local gateways.

**Cost-effectiveness:** The system is cost-effective because the local gateways can perform some basic analytics, which reduces the load on the cloud server.

**Performance:** The system can process data in real time because the local gateways can perform some basic analytics.

Here is a diagram of a hybrid architecture for a railway surveillance system in IoT:



The diagram shows the following components:

**Sensors:** The sensors are located at strategic points along the railway network.

**Local gateways:** The local gateways are connected to the sensors and forward the data to the cloud server.

**Cloud server:** The cloud server stores the data and performs complex analytics, such as video analytics.

**Command and control center:** The command and control center monitors the data from the cloud server and issues alerts and commands to personnel on the ground.

### The information needed to be sent at the higher level

#### Train and Track Information:

- Real-time location and speed of trains.
- Status of switches and signals.
- Track condition, including temperature, wear, and damage.

#### Environmental Conditions:

- Weather data (temperature, humidity, wind speed, precipitation).
- Monitoring for extreme weather conditions (e.g., storms, heavy snow).
- Presence of obstacles or debris on tracks.

#### Safety and Security Data:

- Video feeds from onboard cameras, station cameras, and along the tracks.
- Access control and intrusion detection information for restricted areas.
- Emergency button activations or alarms from trains or stations.

**Maintenance and Performance Metrics:**

- Data on wear and tear of train components (wheels, brakes, etc.).
- Sensor data indicating possible maintenance needs (e.g., abnormal vibration).
- Predictive maintenance analytics and recommendations.

**Passenger Information:**

- Passenger counts on trains and at stations.
- Occupancy levels in different compartments or sections of trains.
- Information on passengers with special needs or assistance requirements.

**CONCLUSION:-** In conclusion, designing an IoT application for a Railway Surveillance System involves selecting suitable protocols, considering efficient data exchange, and implementing an appropriate architecture. The chosen protocols like LoRaWAN and Zigbee enable wireless communication and local interactions. The hybrid architecture, combining edge, fog, and cloud layers, ensures optimal data processing and analysis. By integrating these components, the system can achieve effective monitoring, safety, and performance enhancement across the railway network.