SIT314/SIT729 – Week 4 Group Activity  
Designing Smart IoT Solutions

short line

# Overview

# IoT applications often contain many parts, including data collection with sensors, data aggregation, filtering, storage, analysis, and eventually actuation in the environment such as switching a light on or turning a machine on. This activity is to think about a complex IoT application and design the IoT workflow for it.

# Tasks

You should design the IoT flow for a `transport system for a smart city`.

When thinking about this, think about Sense-Think-Act.

A diagram of a circular cycle

AI-generated content may be incorrect.

1. Sketch a block diagram of the system.

A diagram of a computer

AI-generated content may be incorrect.

Key components:

* Physical layer: Vehicles, pedestrians, infrastructure
* Sensing layer: Cameras, GPS, speed sensors, occupancy detectors
* Network layer: MQTT brokers, gateways
* Processing layer: Traffic analysis, prediction models
* Application layer: Traffic control, navigation systems

1. What are all the physical objects in the space (cars, people, traffic lights)?

* Vehicles: Cars, buses, trucks, bicycles, scooters, emergency vehicles
* Infrastructure: Traffic lights, streetlights, road signs, toll booths, parking meters
* People: Pedestrians, cyclists, traffic officers
* Public Transport: Trains, trams, buses, stations
* Road Elements: Lanes, intersections, crosswalks, bridges

1. What is the data that is generated from sensors (car locations, traffic)?

* Vehicle Data: GPS location, speed, direction, acceleration, occupancy
* Traffic Flow: Vehicle counts, classification (car/truck/bus), queue lengths
* Environmental: Road conditions (wet/icy), visibility, temperature
* Pedestrian: Crosswalk counters, pedestrian density
* Public Transport: Bus/train locations, arrival times, passenger counts
* Infrastructure Status: Traffic light status, parking space availability

1. What are the actuations of the system (traffic lights, car navigation, train speeds)?

* Traffic Control: Adjusting traffic light timing, dynamic lane assignment
* Navigation Systems: Rerouting suggestions to drivers/riders
* Public Transport: Adjusting train/bus frequencies and speeds
* Information Displays: Updating digital signage with traffic info
* Emergency Systems: Prioritizing emergency vehicle routes
* Parking Systems: Guiding drivers to available parking

1. What are the processes and decisions that need to be made to connect the sensors to the actuators?

* Data Fusion: Combining data from multiple sources for accuracy
* Traffic Prediction: Using historical and real-time data to forecast congestion
* Priority Management: Emergency vehicle prioritization
* Load Balancing: Distributing traffic across alternative routes
* Anomaly Detection: Identifying accidents or unusual events
* Demand Response: Adjusting public transport based on demand
* Optimization Algorithms: Minimizing overall travel time

1. Plan a hierarchical MQTT application-level communications protocol. Think about the identity of users and devices in the system and plan single-level or multi-level wildcards for message filtering.

* Topic Structure: smartcity/transport/[region]/[device\_type]/[device\_id]/[data\_type]
* Example topics:

smartcity/transport/central/trafficlight/42/status

smartcity/transport/east/bus/571/location

smartcity/transport/north/parking/zone3/occupancy

* Wildcard Usage:
* Single-level (+): smartcity/transport/+/trafficlight/+/status
* Multi-level (#): smartcity/transport/central/#
* Device Identity Management:
* Each device has a unique ID and publishes to its specific topic
* Devices subscribe to relevant control topics
* Central systems use wildcards to monitor groups of devices
* Security Considerations:
* TLS encryption for all communications
* Device authentication using client certificates
* Fine-grained access control for topics