Theme 3: Connected Infrastructure & Digital Networks

Resilient and scalable infrastructure solutions for the connected world

I01	Smart Water Leak Detection Network

Problem Statement:

Design an IoT system using acoustic sensors and ML to detect water leaks in urban pipe networks. Create a dashboard showing leak probability, location estimates, and prioritized repair recommendations.

Domains: IoT | Acoustic Analysis | Utility Management

Expected Outcome: Detection system prototype with visualization and alert interface

I02	Bridge Health Monitoring Dashboard

Problem Statement:

Build a system that processes sensor data (vibration, strain, temperature) from bridges to assess structural health, detect anomalies, and schedule inspections based on condition-based criteria.

Domains: Structural Health | Sensor Networks | Asset Management

Expected Outcome: Health monitoring dashboard with anomaly alerts and inspection scheduler

I03	5G Network Slice Manager

Problem Statement:

Create a tool that helps network operators dynamically allocate 5G network slices based on application requirements, current demand, and SLA commitments across different service types.

Domains: 5G/Telecom | Resource Management | Network Slicing

Expected Outcome: Slice management interface with demand simulation

I04	Edge Computing Task Offloader

Problem Statement:

Design an algorithm that decides whether to process IoT data locally, at edge nodes, or in the cloud based on latency requirements, bandwidth costs, and computational complexity.

Domains: Edge Computing | Decision Algorithms | Distributed Systems

Expected Outcome: Offloading simulator with latency and cost comparisons

I05	Smart Streetlight Controller

Problem Statement:

Build a system that adaptively controls streetlight brightness based on pedestrian/vehicle presence, ambient light, weather conditions, and energy prices while ensuring safety standards.

Domains: Smart Cities | Energy Efficiency | Adaptive Control

Expected Outcome: Control system prototype with energy savings projections

I06	Fiber Network Fault Predictor

Problem Statement:

Develop a ML model that predicts fiber optic network faults by analyzing performance metrics, environmental data, and historical failure patterns to enable proactive maintenance.

Domains: Telecom | Predictive Maintenance | ML Operations

Expected Outcome: Prediction model with maintenance scheduling recommendations

I07	Underground Utility Mapping Tool

Problem Statement:

Create an application that crowdsources and consolidates underground utility data from multiple sources, helping construction crews avoid accidental damage during excavation.

Domains: GIS | Crowdsourcing | Construction Safety

Expected Outcome: Mapping interface with data integration from multiple utility providers

I08	Smart Bin Collection Optimizer

Problem Statement:

Design a system that uses fill-level sensors on waste bins to optimize collection routes, reducing unnecessary trips while ensuring bins don't overflow. Include dynamic route recalculation.

Domains: Waste Management | Route Optimization | IoT

Expected Outcome: Collection optimizer with route visualization and efficiency metrics

I09	Network Resilience Simulator

Problem Statement:

Build a simulation tool that tests infrastructure network resilience against various failure scenarios (cyber attacks, natural disasters, equipment failures) and suggests hardening priorities.

Domains: Network Security | Simulation | Risk Assessment

Expected Outcome: Resilience testing tool with vulnerability reports and mitigation suggestions

I10	Air Quality Monitoring Mesh

Problem Statement:

Create a low-cost mesh network of air quality sensors for urban areas, with data visualization, pollution source identification, and health advisory generation for affected zones.

Domains: Environmental Monitoring | Mesh Networks | Public Health

Expected Outcome: Monitoring dashboard with pollution maps and health advisories

I11	Digital Twin for Water Treatment

Problem Statement:

Develop a simplified digital twin of a water treatment plant that simulates process changes, predicts chemical consumption, and optimizes energy use while maintaining water quality standards.

Domains: Digital Twin | Process Control | Water Treatment

Expected Outcome: Interactive simulation with optimization recommendations

I12	Cellular Coverage Gap Finder

Problem Statement:

Build a tool that uses crowdsourced signal strength data to identify cellular coverage gaps and dead zones, helping carriers prioritize network investments and users find reliable spots.

Domains: Telecom Analytics | Crowdsourcing | Network Planning

Expected Outcome: Coverage mapping tool with gap analysis and investment prioritization

I13	Smart Parking Guidance System

Problem Statement:

Design a system that uses sensors or camera analytics to guide drivers to available parking spots in real-time, reducing circling time and associated emissions in parking structures.

Domains: Smart Parking | Computer Vision | Traffic Reduction

Expected Outcome: Guidance system prototype with availability display and navigation

I14	Remote Tower Monitoring System

Problem Statement:

Create a dashboard for monitoring remote telecom towers that integrates power status, equipment temperature, security alerts, and environmental conditions with predictive maintenance alerts.

Domains: Remote Monitoring | Telecom Infrastructure | Predictive Analytics

Expected Outcome: Unified monitoring dashboard with alert prioritization

I15	Smart Irrigation Controller

Problem Statement:

Design an intelligent irrigation system that uses soil moisture sensors, weather forecasts, and plant water requirements to optimize watering schedules, reducing water waste in parks and farms.

Domains: Agriculture Tech | Water Conservation | IoT

Expected Outcome: Irrigation controller with water savings projections

I16   Traffic Flow Anomaly Detector

Problem Statement:

Build a system that analyzes traffic camera feeds or sensor data to detect unusual traffic patterns (accidents, road work, events) and automatically adjusts signal timing or alerts authorities.

Domains: Traffic Management | Anomaly Detection | Computer Vision

Expected Outcome: Detection system with alert generation and response recommendations

I17   Satellite Imagery Change Detector

Problem Statement:

Create an automated system that compares satellite imagery over time to detect infrastructure changes (new construction, damage, encroachment) for utility companies and city planners.

Domains: Remote Sensing | Computer Vision | Change Detection

Expected Outcome: Change detection tool with classified alert categories

I18   IoT Device Security Scanner

Problem Statement:

Design a tool that scans IoT devices on a network, identifies vulnerabilities (default passwords, outdated firmware, open ports), and generates remediation recommendations.

Domains: Cybersecurity | IoT | Vulnerability Assessment

Expected Outcome: Scanner with vulnerability report and remediation guide

I19   Noise Pollution Monitoring Network

Problem Statement:

Build a network of noise sensors that maps urban noise levels, identifies sources, tracks patterns over time, and helps enforce noise ordinances and plan quieter neighborhoods.

Domains: Environmental Monitoring | Urban Planning | Sensor Networks

Expected Outcome: Noise mapping dashboard with source identification and trend analysis

I20   Power Line Vegetation Manager

Problem Statement:

Develop a system using drone imagery or satellite data to identify vegetation encroaching on power lines, prioritize trimming locations, and schedule maintenance crews efficiently.

Domains: Utility Management | Image Analysis | Asset Management

Expected Outcome: Vegetation analysis tool with prioritized trimming schedules