Chapter 2
Domain Specific IoTs
Outline

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• Home Automation
• Cities
• Environment
• Energy
• Retail
• Logistics
• Agriculture
• Industry
• Health & Lifestyle
Introduction – Applications of IoT

- Health Care
  - Wearable Electronics
- Industry
  - Machine Diagnosis
  - Indoor Air Quality Monitoring
- Agriculture
  - Smart Irrigation
  - Green House Control
- Logistics
  - Route Scheduling
  - Fleet Tracking
  - Shipment Monitoring
  - Remove Vehicle Diagnostics
- Retail
  - Inventory Management
  - Smart Payments
  - Smart Vending Machines
- Home
  - Smart Lighting
  - Smart Appliances
  - Intrusion Detection
  - Smoke/Gas Detectors
- Cities
  - Smart Parking
  - Smart Roads
  - Structural Health Monitoring
  - Emergency Response
  - Surveillance
- Environment
  - Weather Monitoring
  - Air Pollution Monitoring
  - Noise Pollution Monitoring
  - Forest Fire Detection
- Energy
  - Smart Grids
  - Renewable Energy System
  - Prognostics
Home Automation
Home Automation (2/2)

• Smart Lighting
  • Control lighting by remotely (mobile or web applications)

• Smart Appliances
  • Provide status information to the users remotely

• Intrusion Detection
  • Use security cameras and sensors (PIR sensors and door sensors)
  • Detect intrusions and raise alerts
  • The alerts form: an SMS or an email sent to the user

• Smoke/Gas Detectors
  • Use optical detection, ionization, or air sampling techniques to detect the smoke
  • Gas detectors can detect harmful gases
    • Carbon monoxide (CO)
    • Liquid petroleum gas (LPG)
  • Raise alerts to the user or local fire safety department
Cities (1/2)

- Structural Health Monitoring
- Surveillance
- Emergency Services (Fire, Gas Leak, Water Leakage detection)
- Smart Lighting
- Smart Roads
- Smart Parking
Cities (2/2)

• Smart Parking
  • Detect the number of empty parking slots
  • Send the information over the internet and accessed by smartphones

• Smart Roads
  • Provide information on driving conditions, traffic congestions, accidents
  • Alert for poor driving conditions

• Structural Health Monitoring
  • Monitor the vibration levels in the structures (bridges and buildings)
  • Advance warning for imminent failure of the structure

• Surveillance
  • Use the large number of distributed and internet connected video surveillance cameras
  • Aggregate the video in cloud-based scalable storage solutions

• Emergency Response
  • Used for critical infrastructure monitoring
  • Detect adverse events
Environment (1/2)
Environment (2/2)

- **Weather Monitoring**
  - Collect data from several sensors (temperature, humidity, pressure, etc.)
  - Send the data to cloud-based applications and storage back-ends
- **Air Pollution Monitoring**
  - Monitor emission of harmful gases (CO₂, CO, NO, NO₂, etc.)
  - Factories and automobiles use gaseous and meteorological sensors
  - Integration with a single-chip microcontroller, several air pollution sensors, GPRS-modem, and a GPS module
- **Noise Pollution Monitoring**
  - Use a number of noise monitoring stations
  - Generate noise maps from data collected
- **Forest Fire Detection**
  - Use a number of monitoring nodes deployed at different locations in a forests
    - Use temperature, humidity, light levels, etc.
  - Provide early warning of potential forest fire
  - Estimates the scale and intensity
- **River Floods Detection**
  - Monitoring the water level (using ultrasonic sensors) and flow rate (using the flow velocity sensors)
  - Raise alerts when rapid increase in water level and flow rate is detected
Energy (1/2)
Energy (2/2)

• Smart Grids
  • Collect data regarding electricity generation, consumption, storage (conversion of energy into other forms), distribution, equipment health data
  • Control the consumption of electricity
  • Remotely switch off supply

• Renewable Energy Systems
  • Measure the electrical variables
  • Measure how much the power is fed into the grid

• Prognostics
  • Predict performance of machines or energy systems
    • By collect and analyze the data from sensors
Retail (1/2)
Retail (2/2)

- **Inventory Management**
  - Monitoring the inventory by the RFID readers
  - Tracking the products

- **Smart Payments**
  - Use the NFC
    - Customers store the credit card information in their NFC-enabled

- **Smart Vending Machines**
  - Allow remote monitoring of inventory levels
  - Elastic pricing of products
  - Contact-less payment using NFC
  - Send the data to the cloud for predictive maintenance
    - The information of inventory levels
    - The information of the nearest machine in case a product goes out of stock in a machine
Logistics (1/2)
Logistics (2/2)

• Route Generation & Scheduling
  • Generate end-to-end routes using combination of route patterns
  • Provide route generation queries
  • Can be scale up to serve a large transportation network

• Fleet Tracking
  • Track the locations of the vehicles in real-time
  • Generate alerts for deviations in planned routes

• Shipment monitoring
  • Monitoring the conditions inside containers
  • Using sensors (temperature, pressure, humidity)
  • Detecting food spoilage

• Remote Vehicle Diagnostics
  • Detect faults in the vehicle
  • Warn of impending faults
  • IoT collects the data on vehicle (speed, engine RPM, coolant temperature)
  • Generate alerts and suggest remedial actions
Agriculture (1/2)
Agriculture (2/2)

• Smart Irrigation
  • Use sensors to determine the amount of moisture in the soil
  • Release the flow of water
    • Using predefined moisture levels
  • Water Scheduling

• Green House Control
  • Automatically control the climatological conditions inside a green house
    • Using several sensors to monitor
    • Using actuation devices to control
      • Valves for releasing water and switches for controlling fans
  • Maintenance of agricultural production
Industry (1/2)
Industry (2/2)

• Machine Diagnosis
  • Sensors in machine monitor the operating conditions
    • For example: temperature & vibration levels
  • Collecting and analyzing massive scale machine sensor data
    • For reliability analysis and fault prediction in machines

• Indoor Air Quality Monitoring
  • Use various gas sensors
    • To monitor the harmful and toxic gases (CO, NO, NO₂, etc.)
  • Measure the environmental parameters to determine the indoor air quality
    • Temperature, humidity, gaseous pollutants, aerosol
Health & Lifestyle

• Health & Fitness Monitoring
  • Collect the health-care data
    • Using some sensors: body temperature, heart rate, movement (with accelerometers), etc.
  • Various forms: belts and wrist-bands

• Wearable electronic
  • Assists the daily activities
    • Smart watch
    • Smart shoes
    • Smart wristbands