Chapter 2

Domain Specific IoTs
Outline

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

- Smart Lighting
- Smart Appliances
- Smoke/Fire Detector
- Smart Thermostat
- Intrusion Detection
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)
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 ($CO_2$, $CO$, $NO$, $NO_2$, 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 ($CO$, $NO$, $NO_2$, 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