Internet of Things
A Hands-On Approach

Chapter 9:
Case Studies Illustrating IoT Design

Outline

- Smart Lighting
- Home Intrusion Detection
- Smart Parking
- Weather Monitoring System
- Weather Reporting Bot
- Air Pollution Monitoring
- Forest Fire Detection
- Smart Irrigation
- IoT Printer

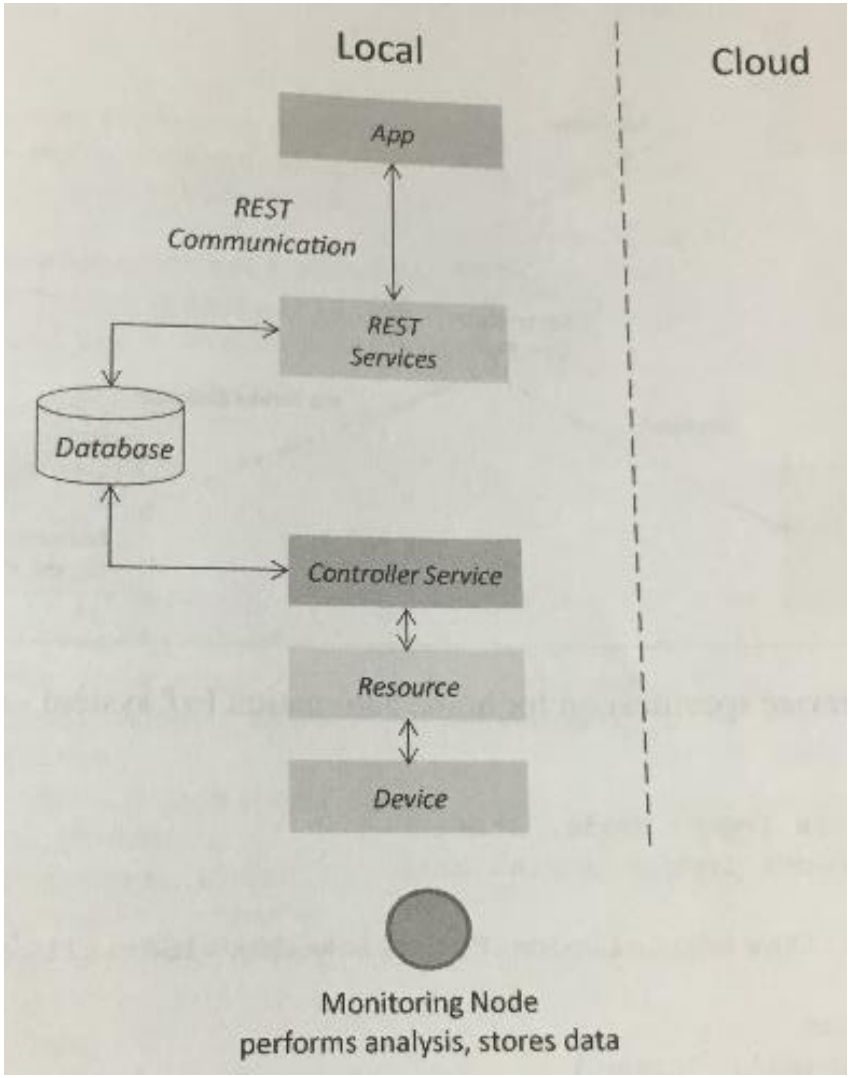
Smart Lighting

A design of a smart home automation system:

- **Control** the **lights** in a typical home remotely using a web application.
- The system include **auto** and **manual** modes.

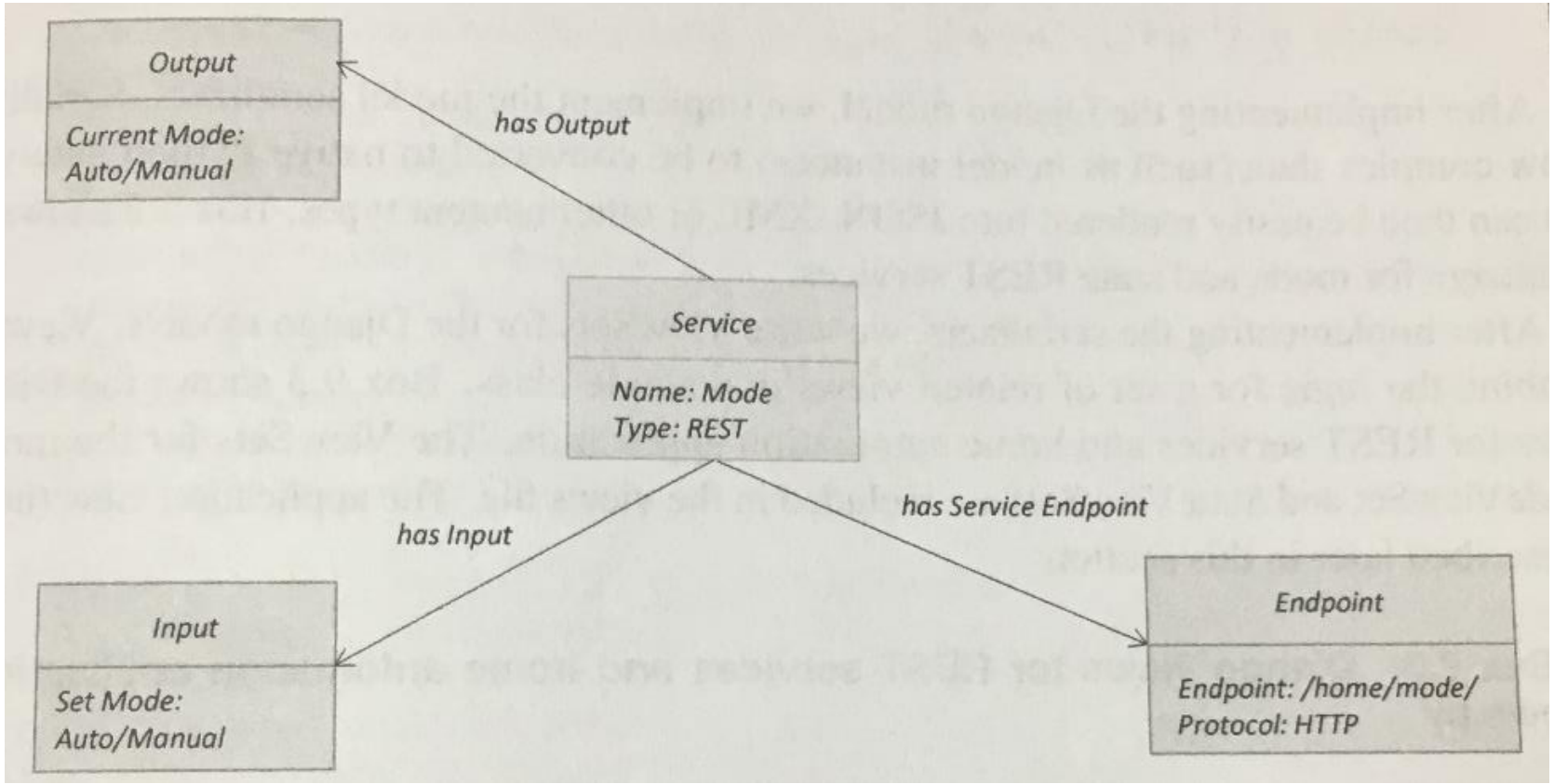
Smart Lighting

- Deployment design



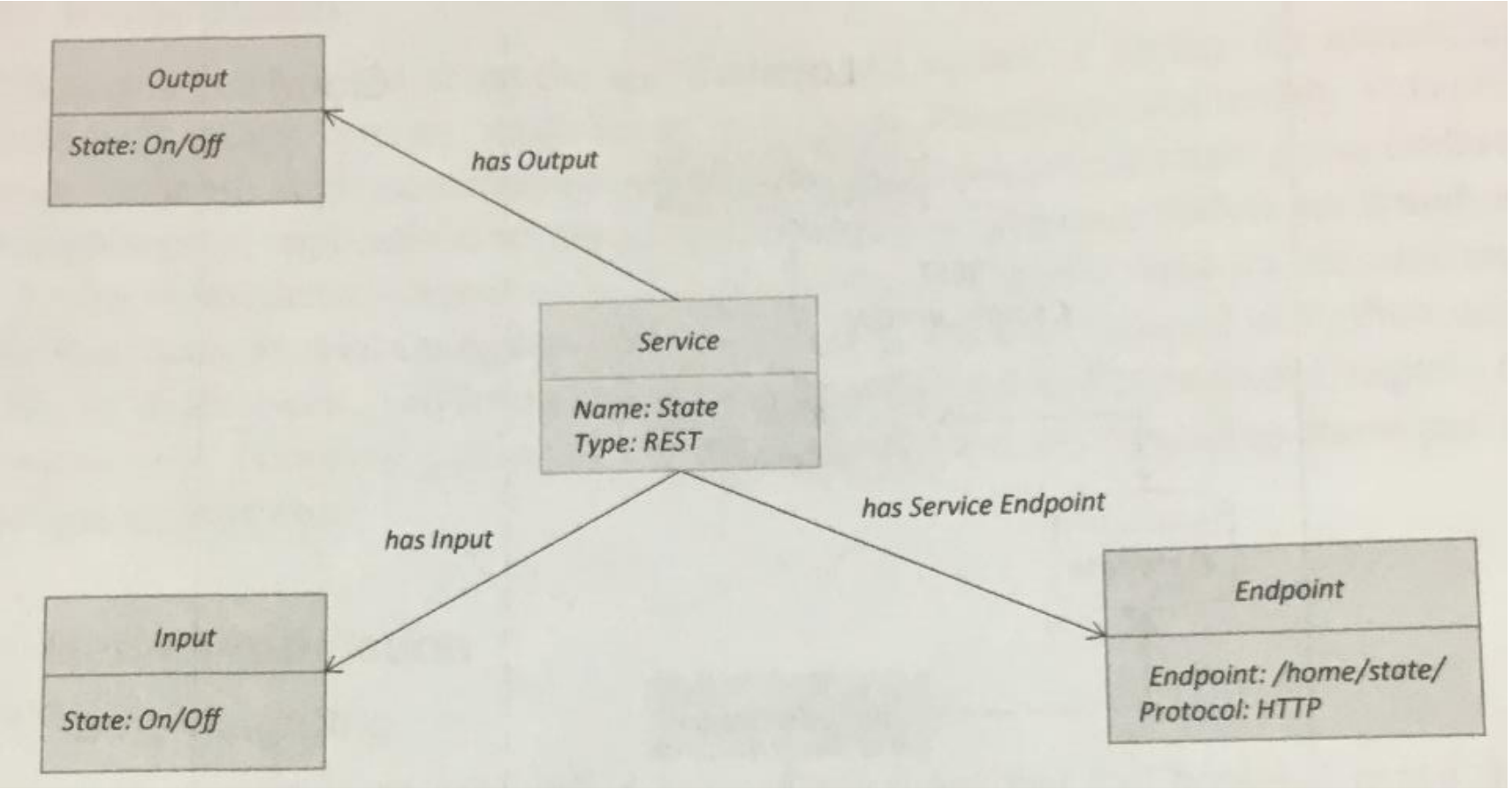
Smart Lighting

- Mode service



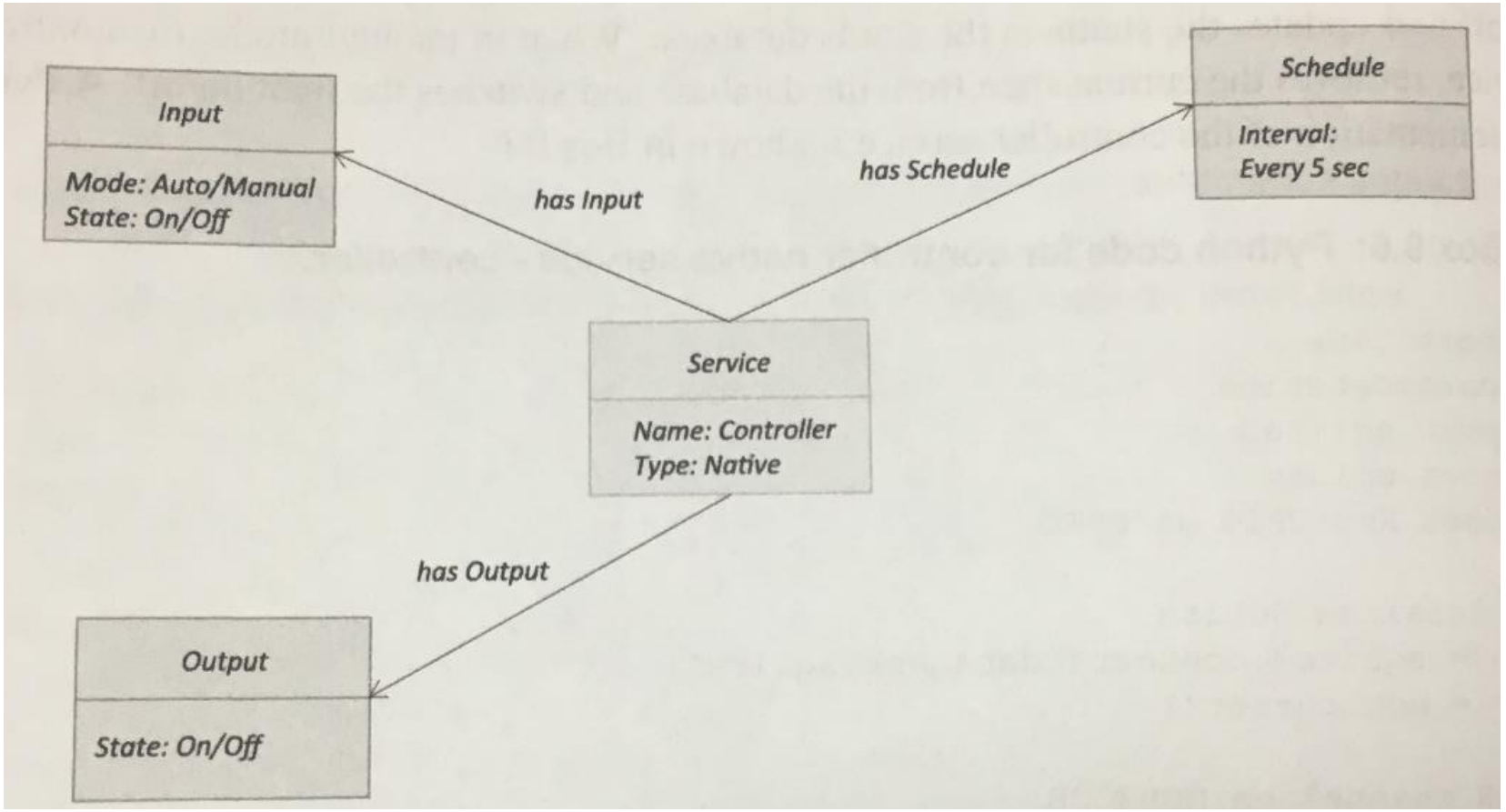
Smart Lighting

- State service



Smart Lighting

- Controller service



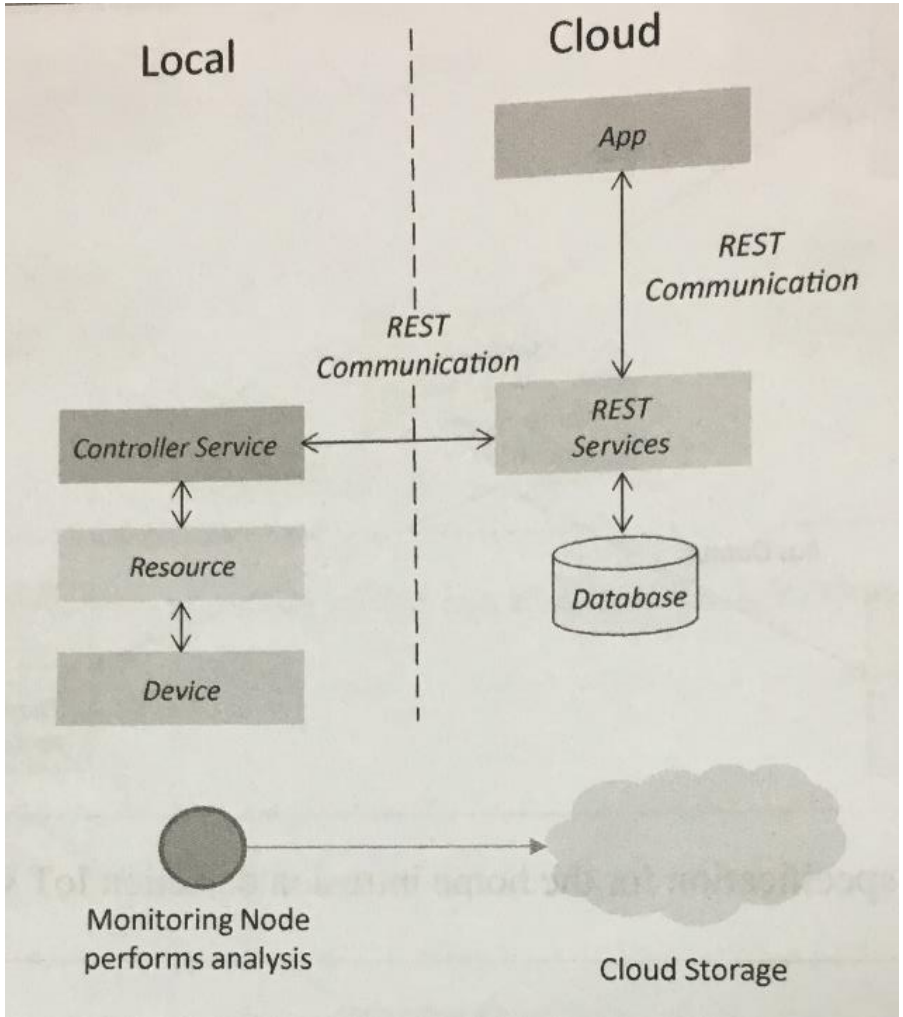
Home Intrusion Detection

A design of home intrusion detection systems:

- **Detect intrusions** using sensors and **raise alerts**, if necessary.
- Each **door** has a door sensor to **detect opening of door**.
- Each **room** has a PIR motion sensor to **detect motion**.

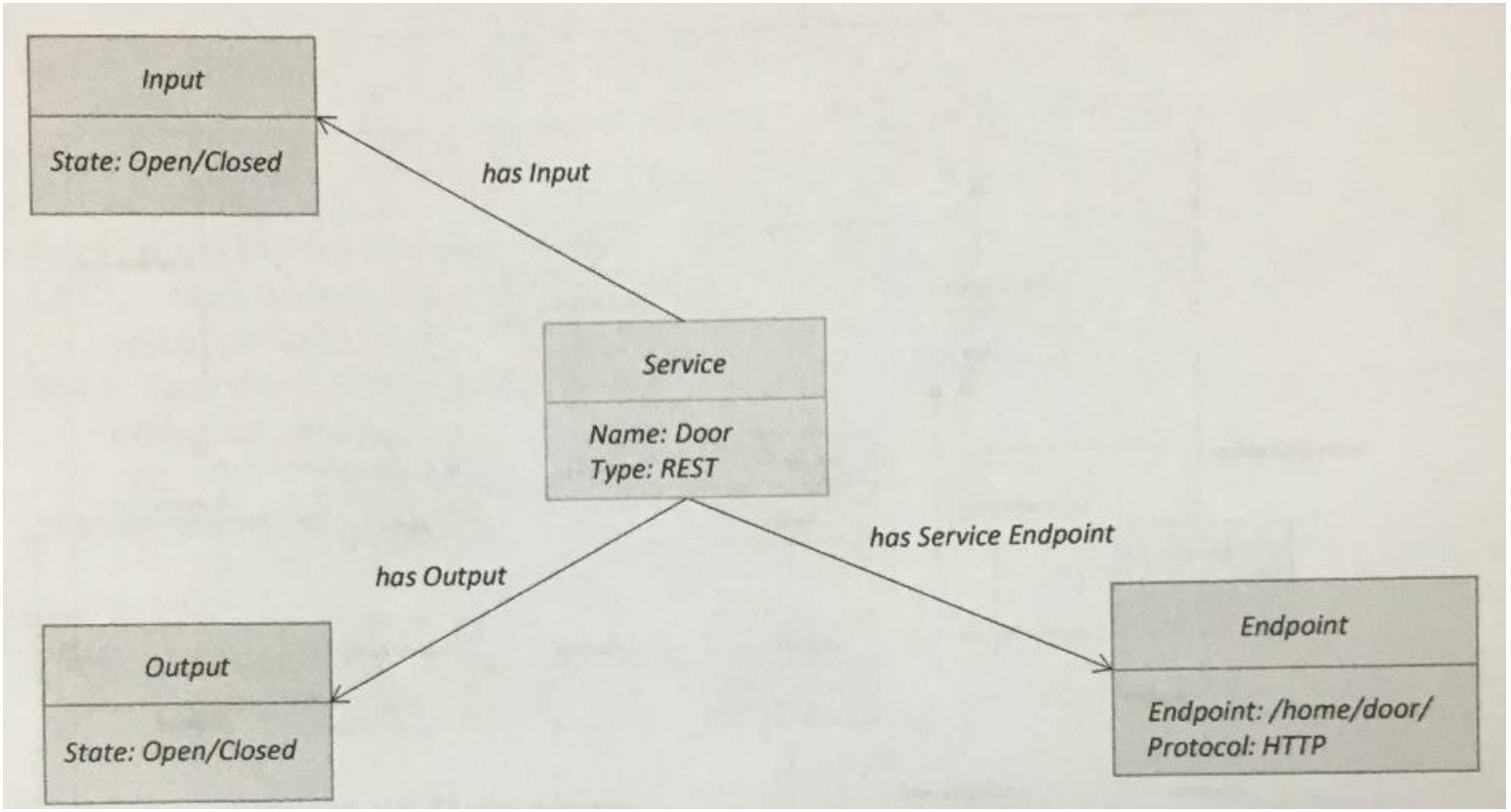
Home Intrusion Detection

- Deployment design



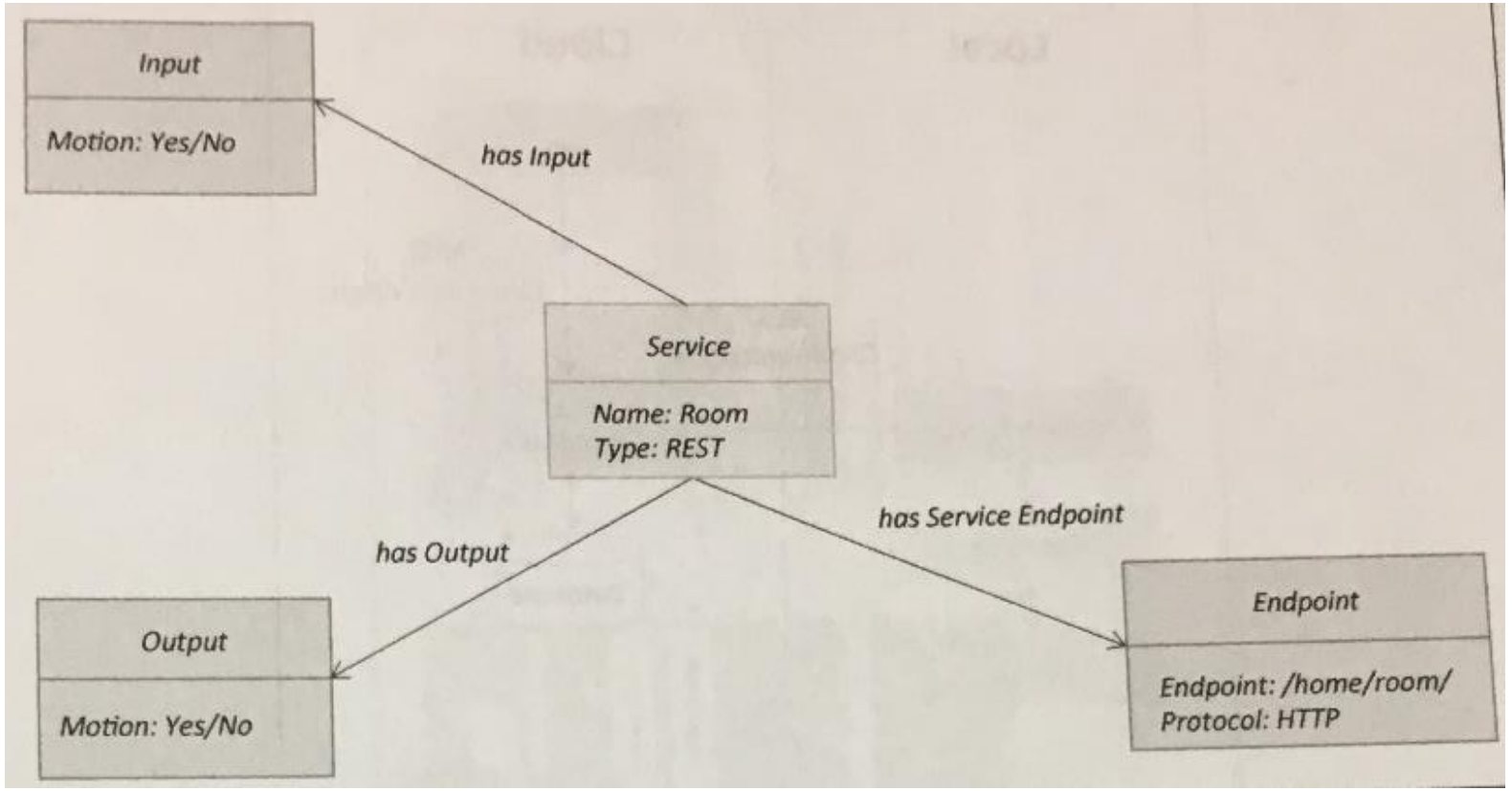
Home Intrusion Detection

- Door service



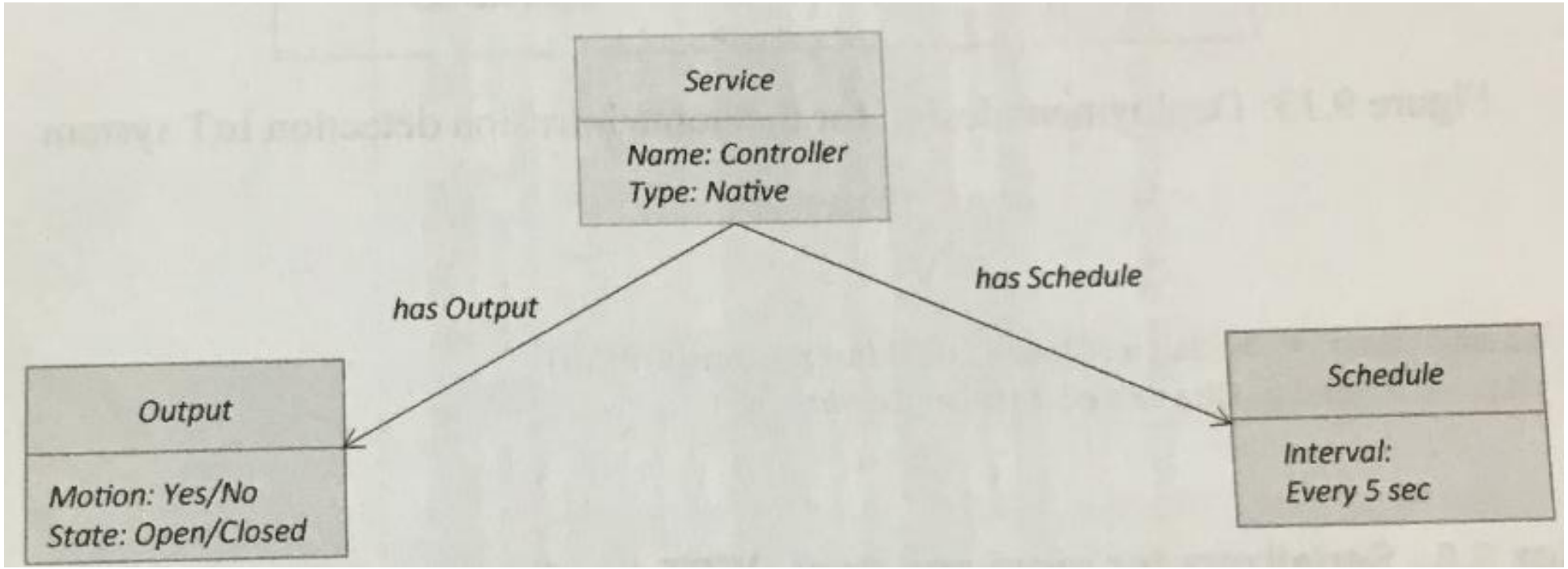
Home Intrusion Detection

- Room service



Home Intrusion Detection

- Controller service



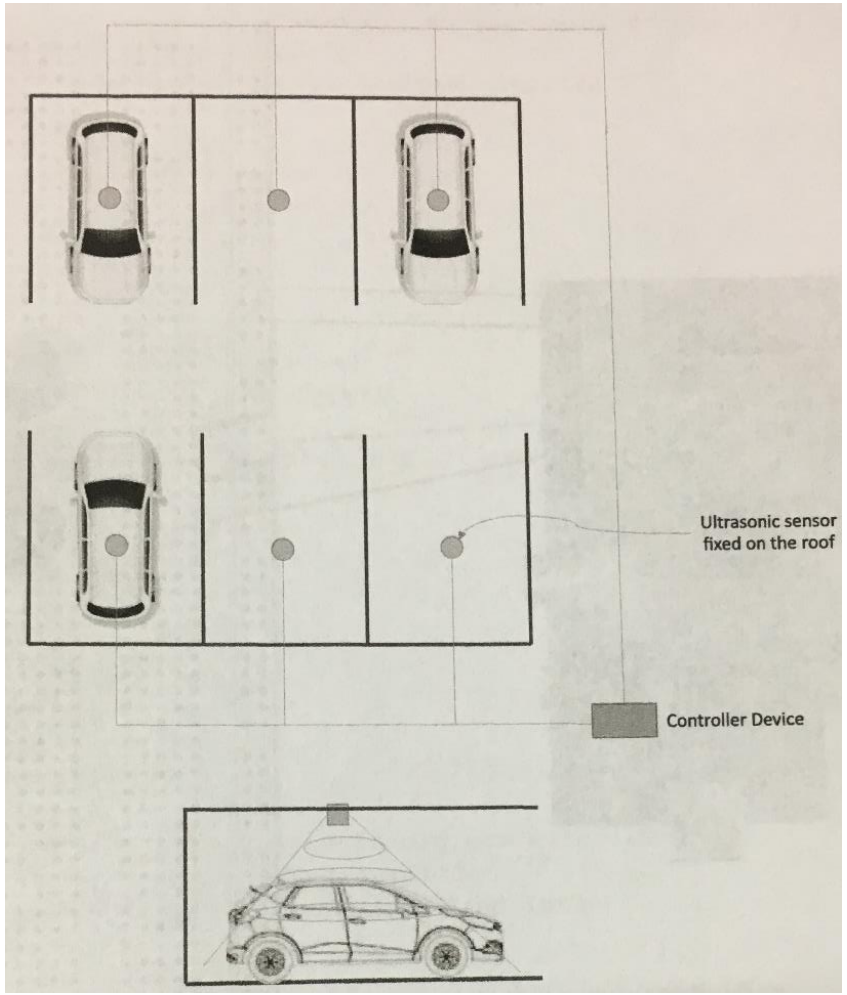
Smart Parking

A design of smart parking systems:

- Detect the number of empty parking slots to help drivers search parking space easily.
- Each parking slot have a sensor to detect whether the slot is empty or occupied.

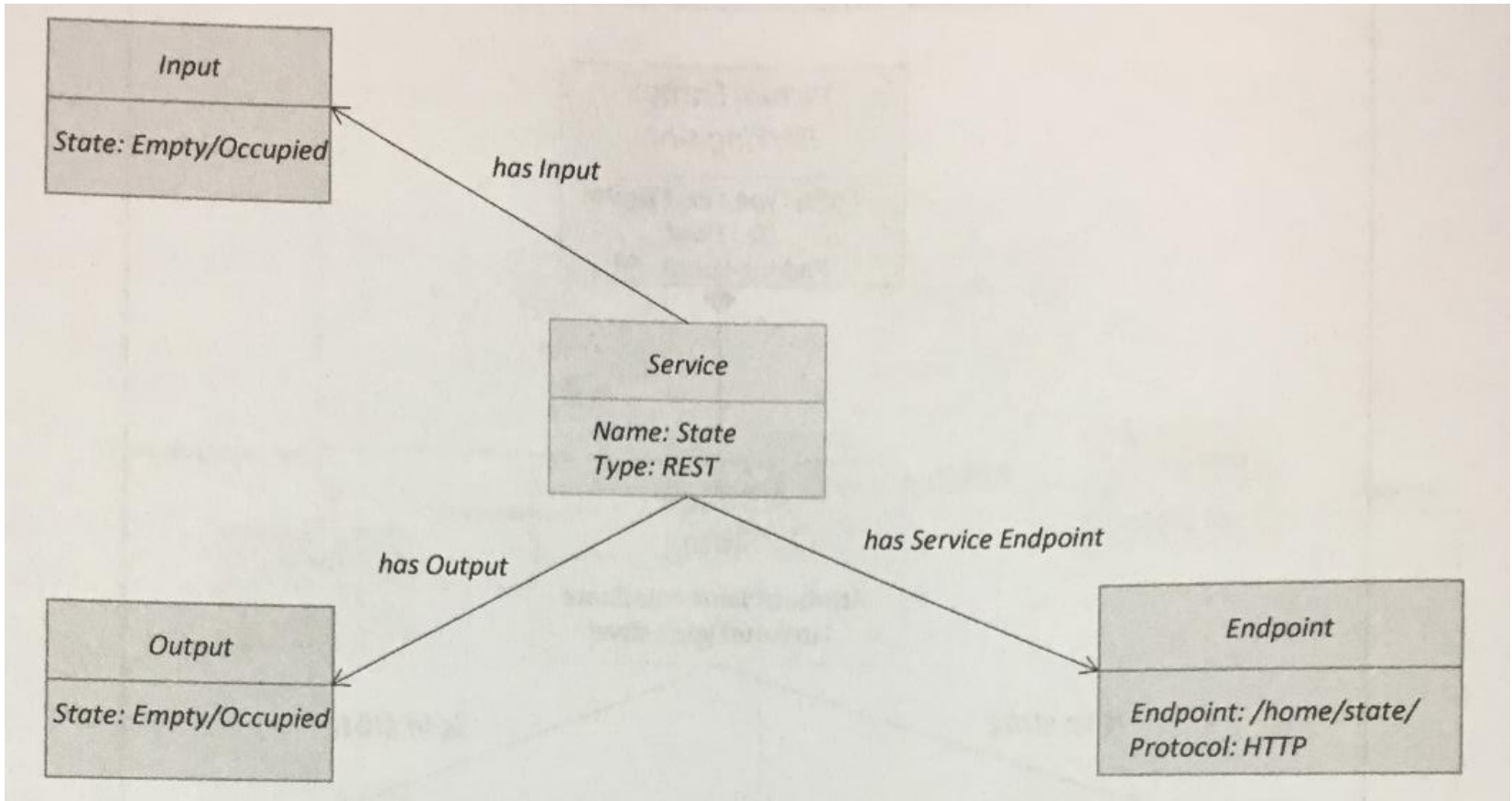
Smart Parking

- Deployment of sensors



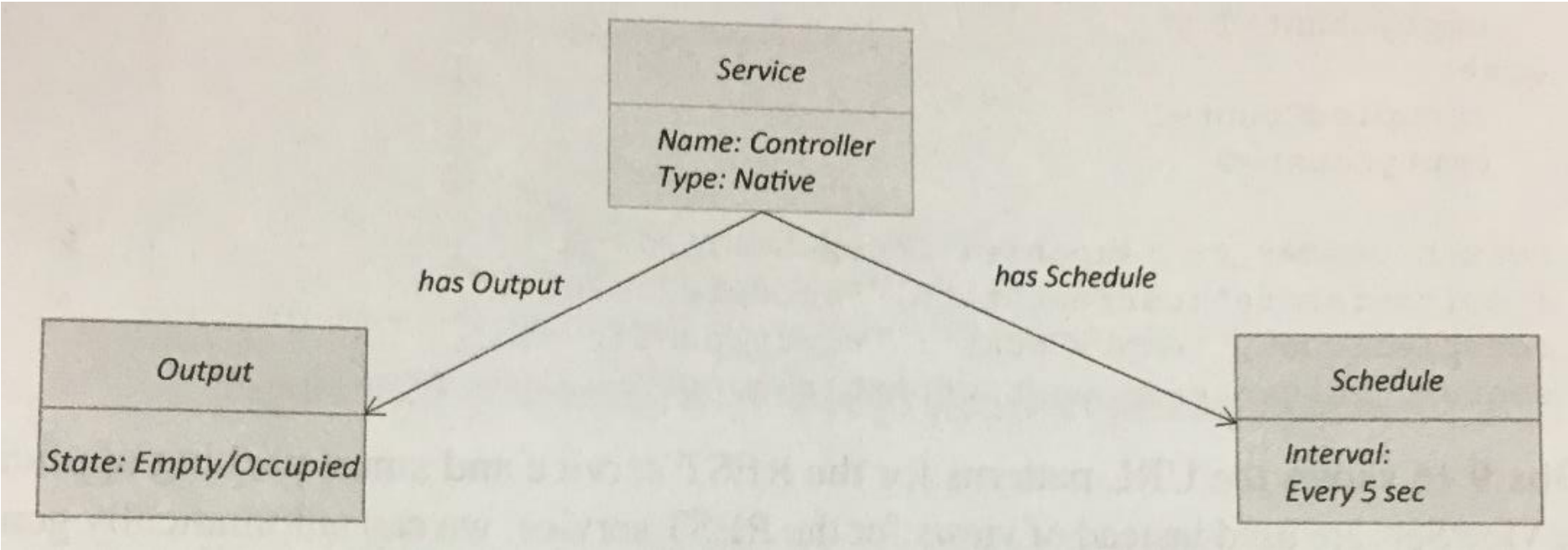
Smart Parking

- State service



Smart Parking

- Controller service



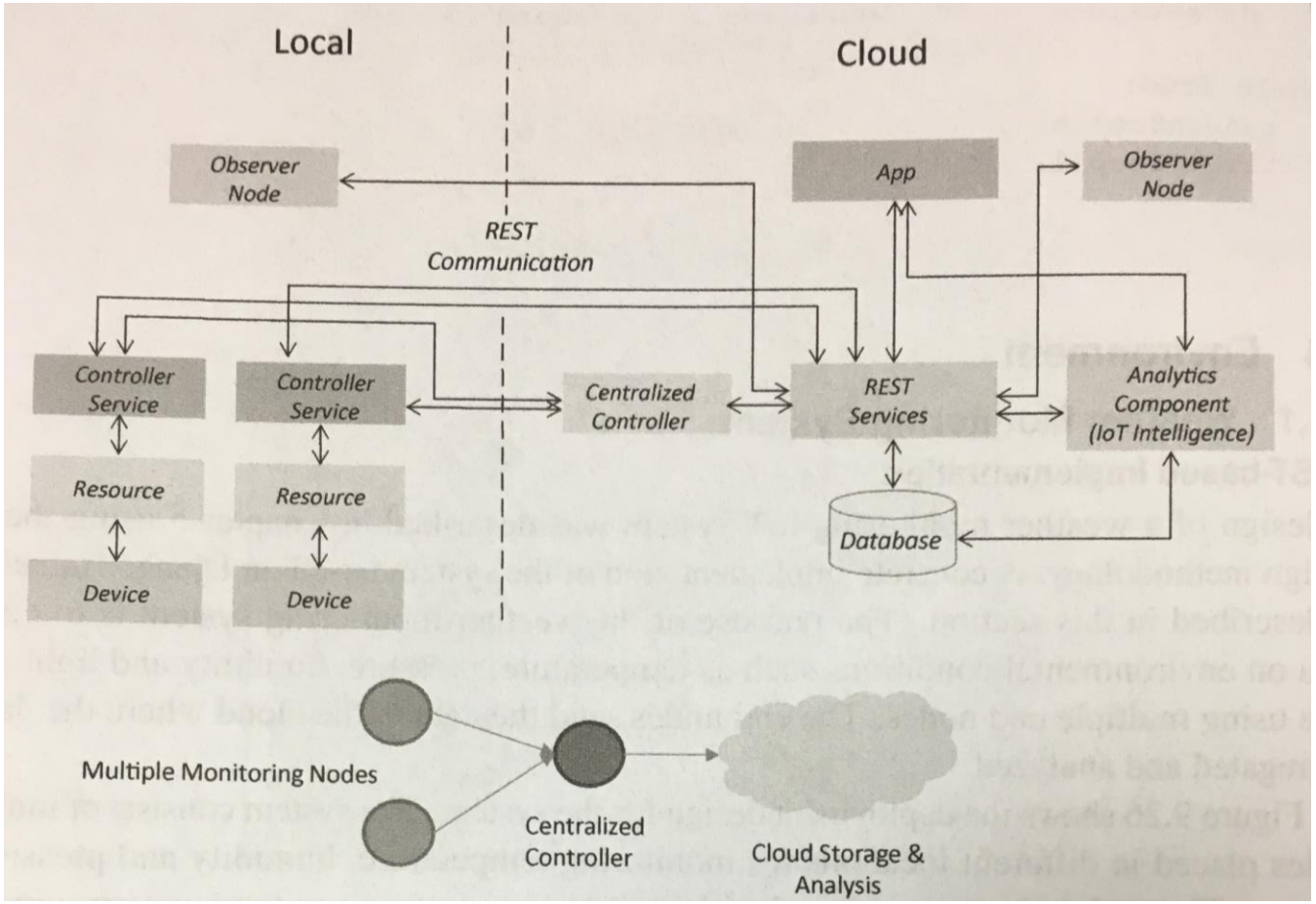
Weather Monitoring System

A design of a weather monitoring IoT system:

- Collect data on environmental conditions such as temperature, pressure, humidity and light in area using multiple end nodes.
- The end nodes send the data to the cloud where the data is aggregated and analyzed.
- The end nodes are equipped with various sensors (such as temperature, pressure, humidity and light).

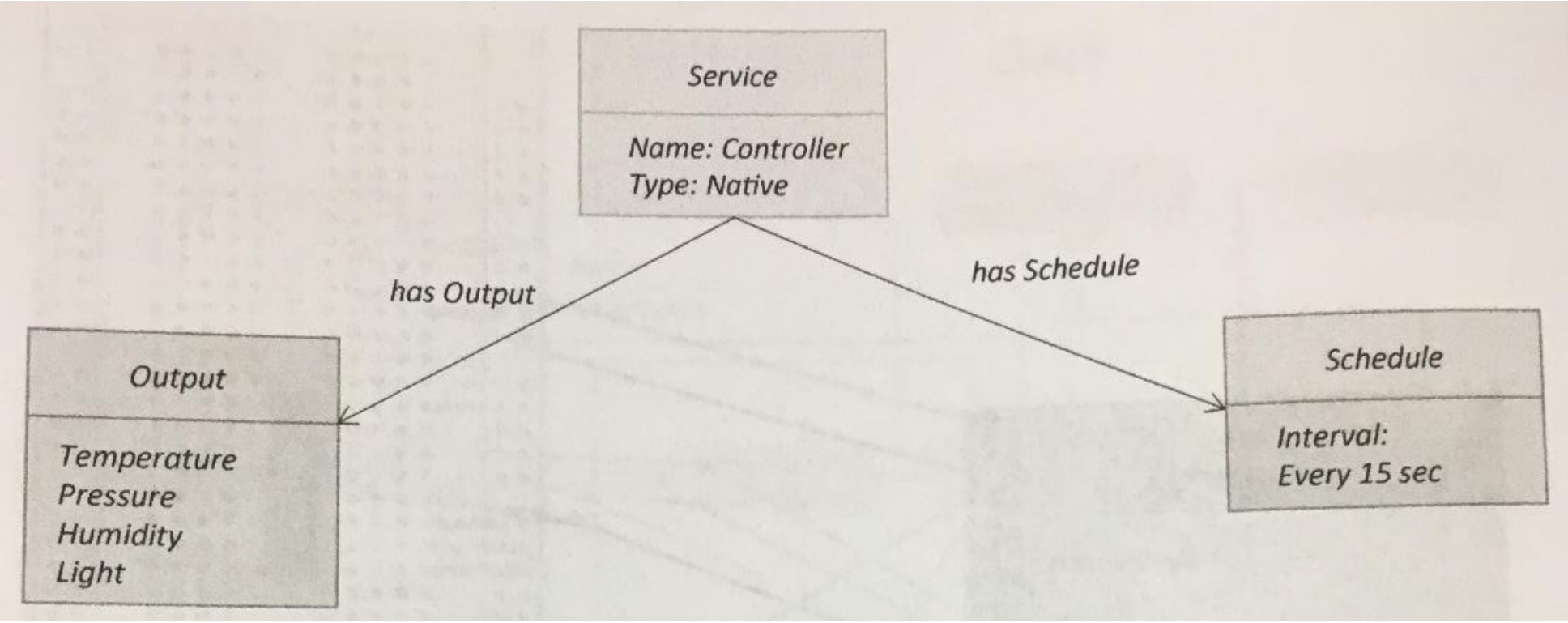
Weather Monitoring System

- Deployment design



Weather Monitoring System

- Controller service



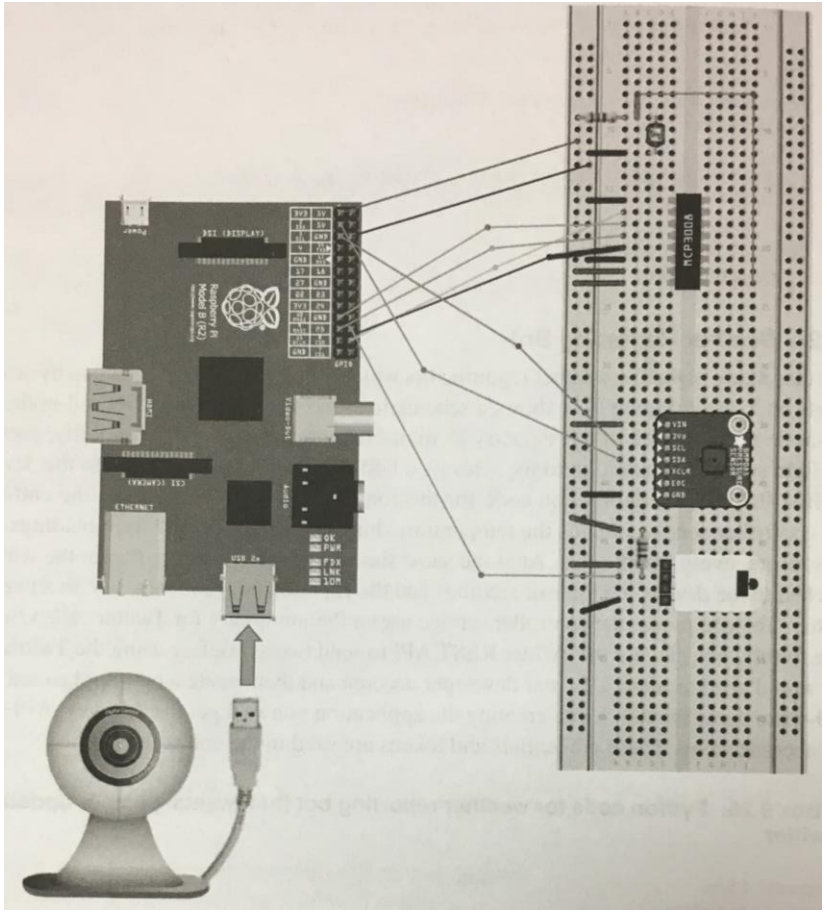
Weather Reporting Bot

A design of a weather reporting bot:

- Report weather information by sending tweets on Twitter.
- The end nodes are comprised of a Raspberry Pi mini-computer, temperature, pressure, humidity and light sensors. In addition to the sensors, a USB webcam is also attached to the device.
- To send tweets:
  - Using a Python library for Twitter called *tweepy*.
  - With tweepy we can use the Twitter REST API to send tweets.

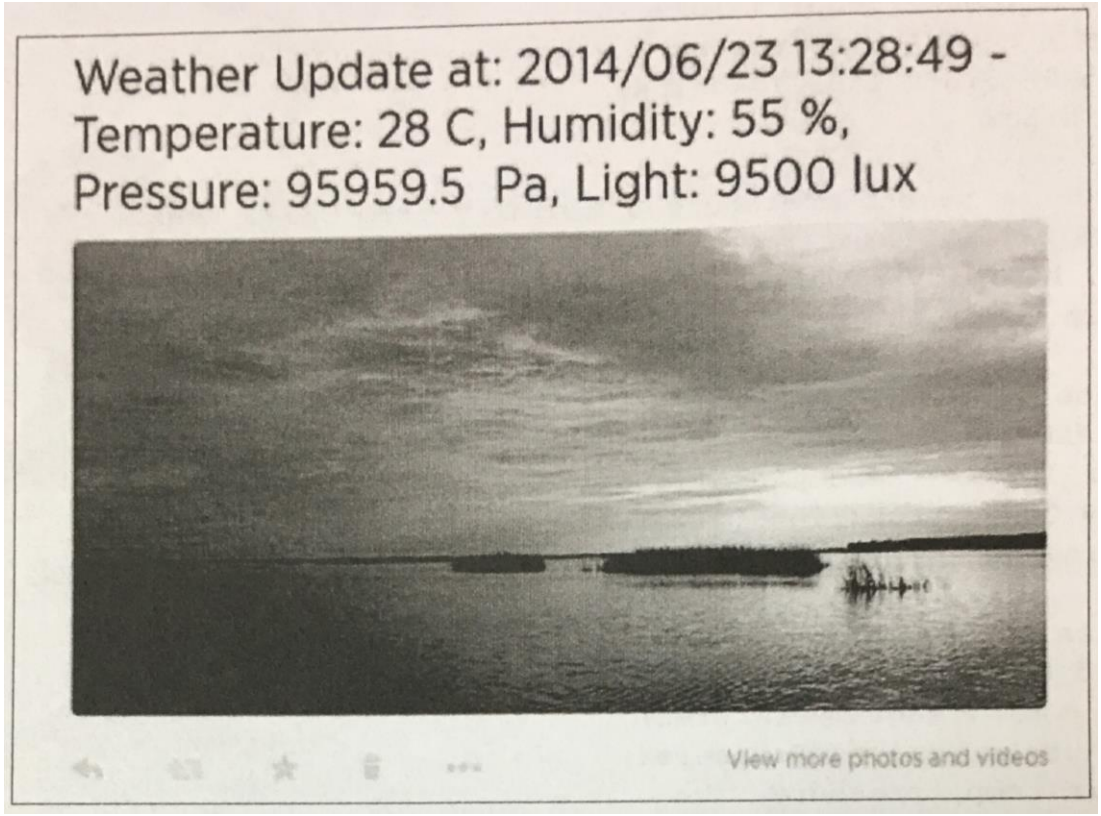
Weather Reporting Bot

- Schematic diagram – device and sensors.



Weather Reporting Bot

- Screenshot of a weather update tweeted.

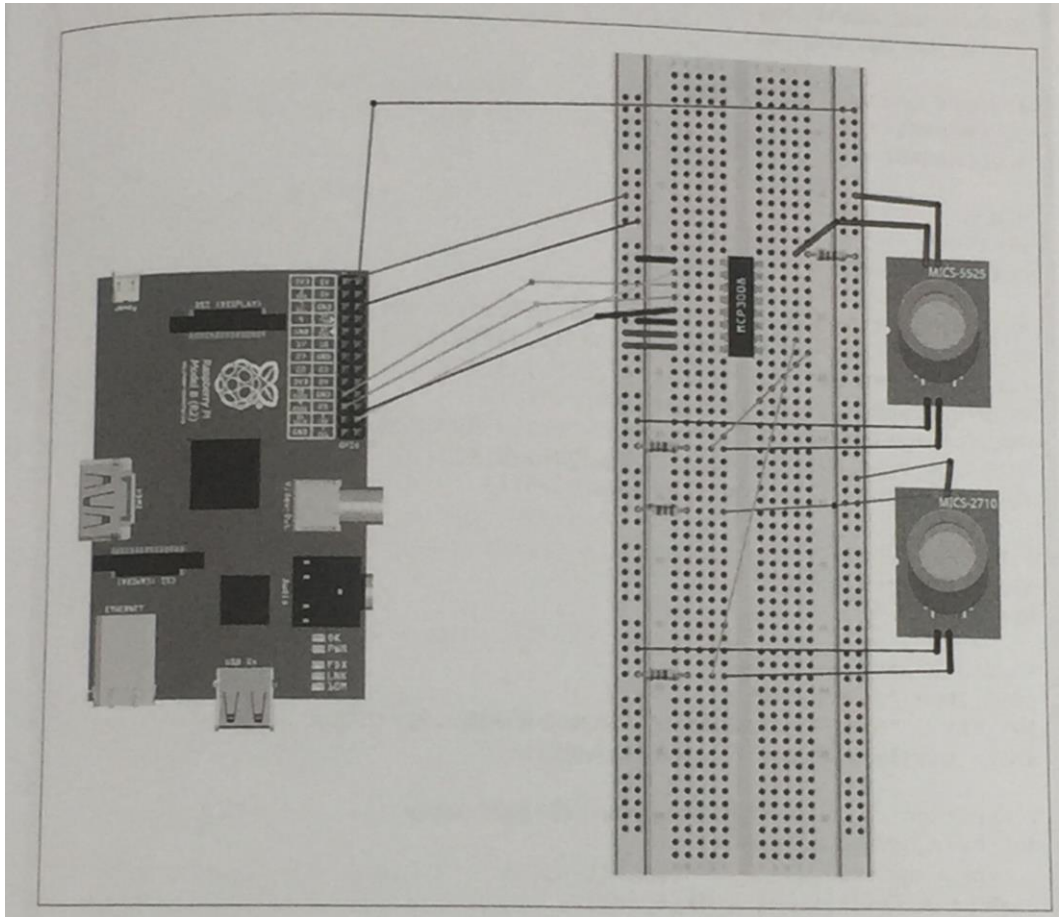


Air Pollution Monitoring

A design of an air pollution monitoring:

- Multiple nodes placed in different locations for monitoring air pollution in an area.
- End nodes: CO and NO_2 sensors
- Send data to the cloud database
- Visualizing the data with cloud-based application

Air Pollution Monitoring

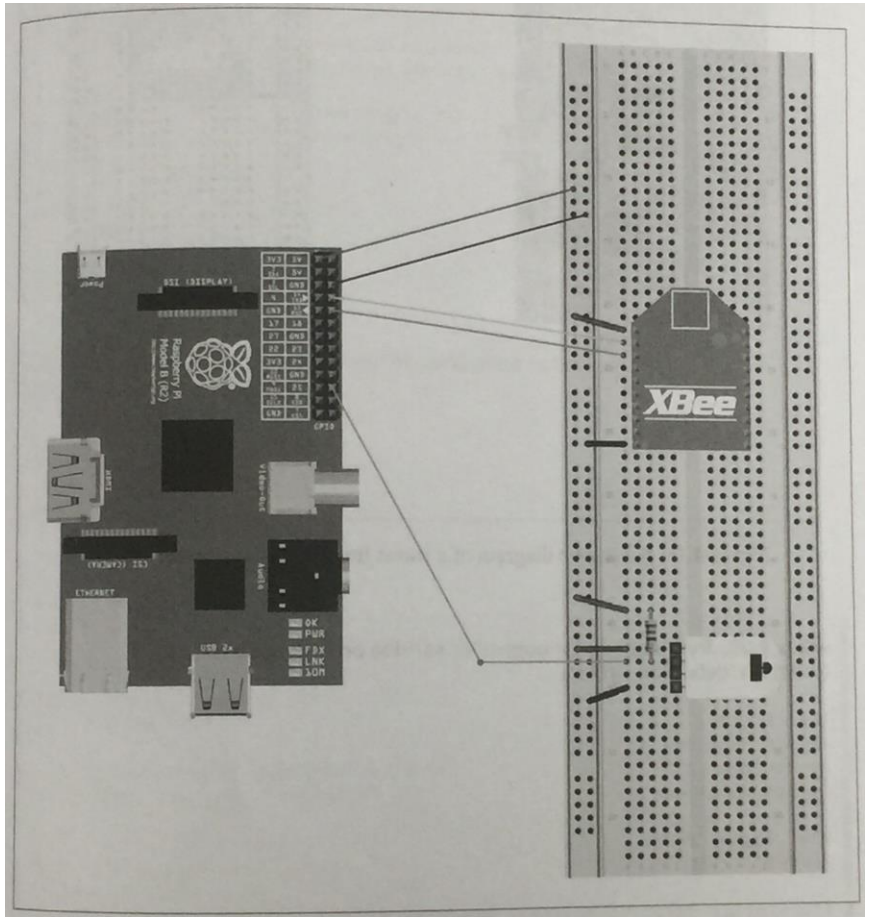


Forest Fire Detection

A design of a forest fire detection:

- A number of monitoring nodes (end nodes) deployed at different locations in a forest.
- End nodes collect measurements (like temperature and humidity) to predict whether a fire has broken out.
- Use one coordinator node to collect all data from end nodes through XBee module.
- Coordinator service calls rest api to send data to cloud.

Forest Fire Detection

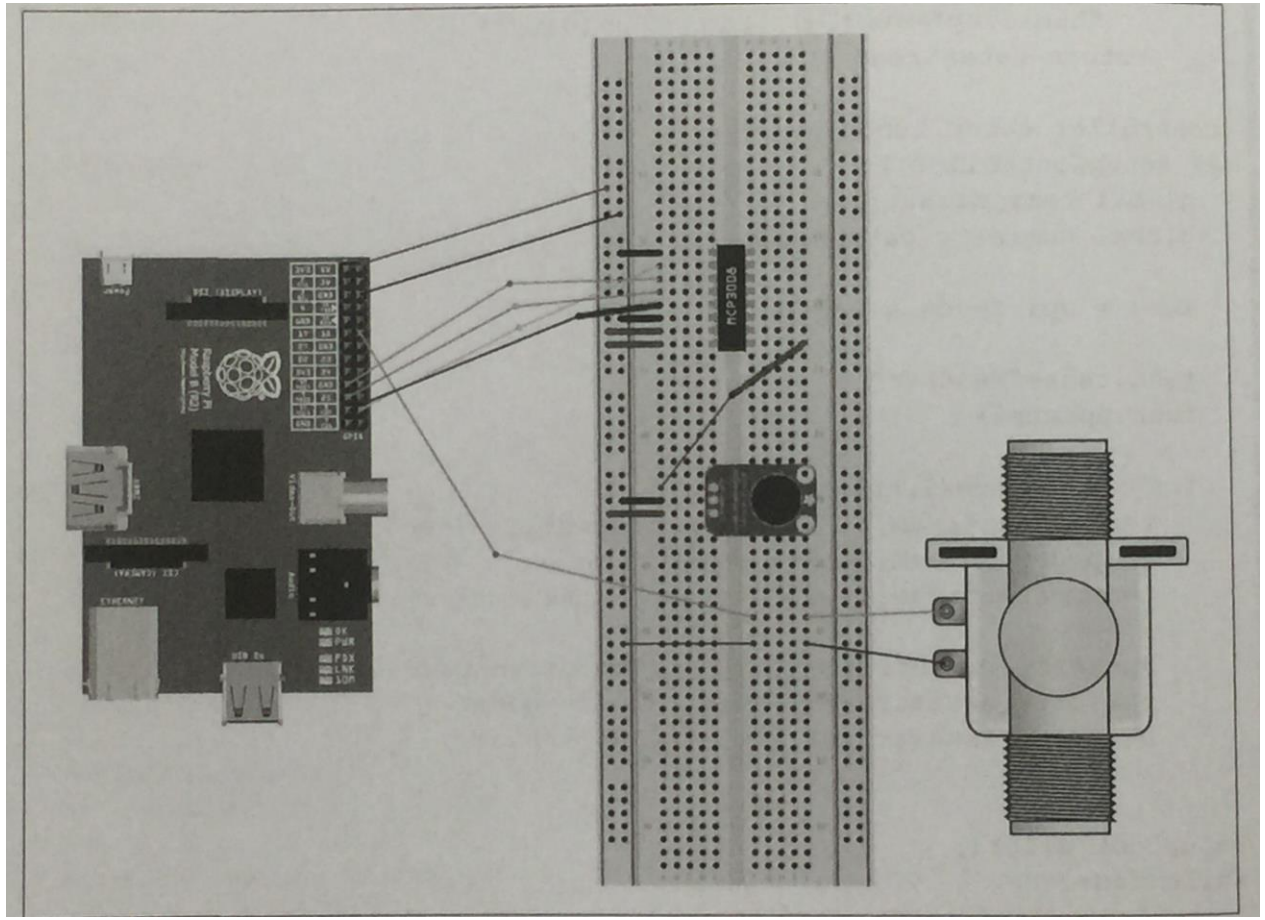


Smart Irrigation

A design of a smart irrigation:

- Multiple monitoring nodes (end nodes) placed in different locations for monitoring soil moisture.
- End nodes send data to cloud through Raspberry Pi.
- Cloud-based application visualize the data.
- A solenoid valve is used to control the flow of water, which connects to Raspberry Pi.

Smart Irrigation



IoT Printer

A design of an IoT printer:

- Fetch daily briefing information (today's weather prediction, …) on the Internet.
- Login to the google calendar to fetch your schedule.
- Write to a file and then print every morning.

IoT Printer