Design for Change

17-423/723 Software System Design

Recitation 4
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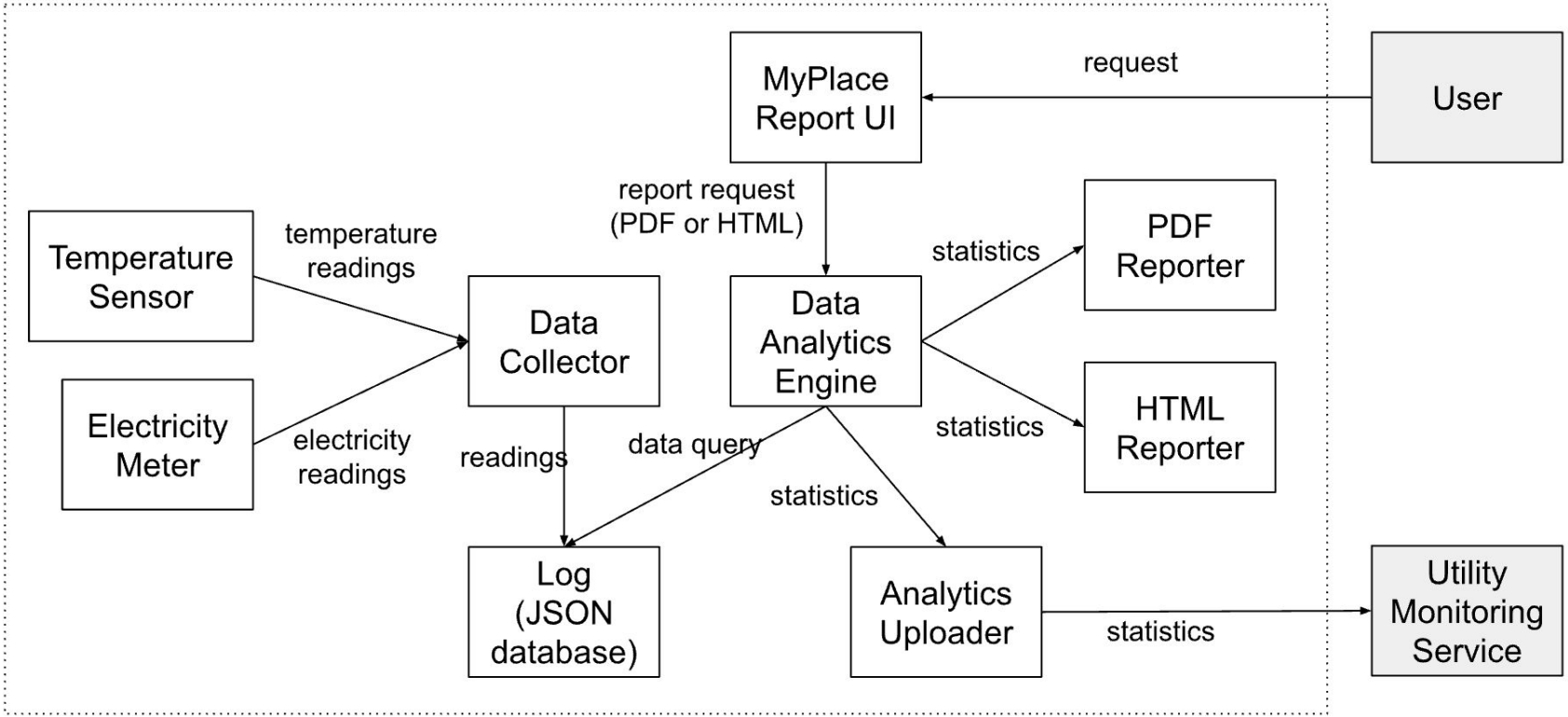
Example: Smart Home Meter System

MyPlace: Smart Home Meter System

MyPlace is an Internet-of-the-Things (IoT) system that periodically collects data from different types of sensors throughout a smart building (temperature sensors, electricity meters, etc.,) and provides the building owner with various statistics about the collected information (e.g., temperature trends over the week, average and maximum electricity usage, etc.,). Below is a component diagram that shows the current design of the system; User and Utility Monitoring Service are domain entities that interact with the system.

MyPlace: Component Diagram



Component Responsibilities

- Temperature sensor, electricity meter: Provides current temperature readings/electricity readings.
- Data collector: Periodically polls and stores the readings received from the sensors/meters into a log database.
- Log: Stores all of the past readings as a database.
- Data analytics engine: Based on the user request from the UI, queries the log database for necessary data and computes the requested statistics (e.g., “average electricity usage for the last 6 months”). Then, the engine passes the statistics to either the PDF or HTML reporter (depending on the type of request) and returns the generated report back to the UI. In addition, the engine periodically computes a predefined set of statistics (e.g., “weekly electricity consumption”) and sends it to the analytics uploader.

Component Responsibilities

- **MyPlace report UI**: The frontend for the system. Receives requests from the user to generate statistics reports either in form of (1) HTML, to be immediately displayed on a browser or (2) PDF, to be downloaded and stored on the user's device for archival purposes.
- **Analytics uploader:** Uploads the statistics computed by the analytics engine to the external utility monitoring service.
- **PDF/HTML reporter**: Given the statistics from the analytics engine, produce a report either in PDF or HTML format.

Activities

Q1. What are possible changes that may occur in the MyPlace system? Describe the impact of each change on the rest of the system.

Q2. Does the system violate any of the following principles? If so, how would you redesign the system to fix those violations and improve the changeability of the system? Draw a component diagram for the redesigned system.

- Information hiding
- Single-responsibility
- Interface segregation
- Dependency inversion

Discussion

Which of the proposed design changes from Q2 would you choose to implement, and which ones would you skip/delay? What factors inform your decision?

Interface Specification: Example

List<Reading> fetchReadings(sensorType: String, startDate: DateTime, endDate: DateTime)

requires: sensorType must be either “temperature” or “electricity”

effects: computes the time period between startDate and endDate and returns the list of sensor readings for each time step in the period

Deterministic vs. under-determined?
Declarative vs operational?
Strong vs. weak?
General vs. restrictive?