جامعة الأمير مقرن بن عبد العزيز
University of Prince Mugrin

Department of Software Engineering
College of Computer and Cyber Sciences
Software Engineering Department

SE342 – Software Architecture and Design Project

Semester 2 (Spring 2023)

Overview

Assume that you are working as a software architect for a company that is specialized in developing solutions for one or more of the following domains:

- E-Commerce
- Safety
- Transportation and logistics (2 projects)
- Governance and security
- Robots

The company wants to develop a solution that provides specific services with quality attributes, as described in the "Scenarios" section in Pages 3-4.

What is required

Design the required system and provide the needed diagrams of your proposed system architecture, representing key elements (components, objects, interfaces, and relationships) and how these elements interact with each other. In a report that documents your architecture, you must also explain the following:

1. What design principles did you apply when designing the system.
2. How did these principles guide your design decisions.
3. What architectural patterns did you employ to develop design specifications. Why this pattern(s) was selected, and how each pattern contributes to solving the identified problem.
4. How the proposed design took into account the required quality attributes (e.g. scalability, security, …etc.).
5. How will your system handle changing market conditions and adapt to new trends.

Submission Date:	On or before **Sunday 14/5/2023 – 5:00pm**
Deliverables:	1. A written report (PDF) + the original diagram files to be sent to k.khankan@upm.edu.sa 2. An oral presentation on **Tuesday 23/5/2023 11:00am**
Work Type:	Group work (4 students per group)
Targeted Learning Outcomes:	▪ C.L.O 1.2: Identify middleware architectures and frameworks ▪ C.L.O 2.1: Apply design principles to architect a software that solves an identified problem. ▪ C.L.O 2.2: Employ appropriate patterns and architectural styles for developing design specifications. ▪ C.L.O 2.3: Evaluate existing software architectures and possible refactoring options. ▪ C.L.O 3.1: Work professionally with a development team to deliver quality software design. ▪ C.L.O 3.2: Demonstrate effective oral and written communication skills.
Marks:	25 Marks
Assessment Criteria:	1. Applying design principles to architect the software that solves the problem at hand. This includes the required explanations (1 - 5), mentioned in Page 1. [7 marks] 2. Employing appropriate patterns and architectural styles for developing design models and specifications. [4 marks] 3. Identifying the needed middleware architecture and framework. [3 marks] 4. Evaluating the proposed software architecture [4 marks] 5. Working professionally with a development team to deliver quality software design. [5 marks] 6. Demonstrating effective oral and written communication skills. [2 marks] All these aspects will be assessed via the report, presentation, and discussion

Penalties:	▪ **Late submission:** Any time after Sunday 14/5/2023 – 5:00pm 1 mark per day will be deducted. However, any submission after Wednesday 17/5/2023 WILL NOT BE ACCEPTED. ▪ **Plagiarism:** In case of plagiarism or use of **ChatGPT**, zero tolerance policy will be applied. This means that the submitted report will be rejected and **zero** marks will be given.

Scenarios

1. E-Commerce

You have been tasked with designing a software system/portal for marketplace (e.g. www.alibaba.com), where suppliers (factories) can present their products and buyers can browse catalogues, order products, choose shipping options, and pay via various payment methods. The portal allows suppliers to sell their products in different standard quantities. As a software architect, you need to design a solution using appropriate design principles and architectural patterns. The solution should address the given functional requirements without compromising scalability, performance, and security.

2. Safety

You are working as a software architect for a company that provides AI-based monitoring solutions for swimming pools. Using appropriate design principles and architectural patterns, design an AI-based monitoring software system that can accurately detect if someone might be drowning in a swimming pool. The solution should address the given functional requirements without compromising performance, privacy, and modifiability.

3. Transportation and logistics

Scenario-A

You are working for a transportation company that wants to build a new logistics management solution. The company has a fleet of trucks equipped with GPS sensors, and wants to track the movement of goods, optimize transportation routes, and provide real-time updates to customers. They want to develop an IoT system that can track the location of the trucks and the condition of the goods they are carrying. As the company will be collecting a large amount of data on transportation times, vehicle performance, fuel consumption, and goods conditions at various trips, they wanted also a smart AI based solution that can analyze the collected data to further optimize transportation routes and reduce costs. This IoT based solution should address the given functional requirements while ensuring data accuracy, real-time updates, scalability, reliability, and data security.

Scenario-B

In addition, the company wants to include a Smart Safety System (SSS) for the drivers. The system should alert drivers to potential various hazards, road work, weather conditions, …etc. using multiple modalities such as visual and audio alerts or feedback (multimodal interaction). The solution should address the given functional requirements while ensuring performance, usability, and accuracy.

4. Governance and security

You are working for a city government that wants to improve traffic flow using IoT. The city wants to develop an IoT system that can collect data on traffic volume, vehicle speed, and congestion, and use this data to optimize traffic signals and reduce congestion. The solution should address the given functional requirements while ensuring privacy, scalability, and modifiability. In addition, the government wants to secure its IT infrastructure, including the required solution and other existing solutions against cyber-attacks (threat detection and response). Sensitive data and reports are confidential and must be protected from unauthorized access (access control).

5. Robots:

UPM wants to develop a new robot for picking up recyclable bottles and cups. The robot should be able to perform tasks such as *pick-and-place* with high precision and reliability. The robot should be able to navigate the university building (withing the same floor), pick and place bottles and cups, and communicate with human workers in with a multimodal kind of interaction. In addition, the robot will do surveillance tasks and should be able to patrol an area, detect intruders, and alert security personnel. The solution should address the given functional requirements while ensuring performance, usability, and accuracy.

Additional scenarios:

6. Smart Digital auction platform

Smart Digital auction platform for auction management is a solution that can streamline the auction process, improve efficiency, and enhance the overall experience for auctioneers, sellers, and bidders. Web and mobile applications that allow users to participate in auctions physically or remotely. Users can access catalogs, item descriptions, and place bids in real-time. This will make auctions accessible for permitted bidders anywhere, anytime. The solution should provide seamless payment processing to improve the overall user experience. This includes integrated secure and user-friendly payment gateways to enable smooth and efficient payment processing that reduces transaction times. Inventory management and logistics: Implement smart inventory management systems to track auction items, manage consignments, and coordinate shipping and storage logistics.

7. Scenario: Smart City Transportation Management System

The system should efficiently support various transportations, such as trains, buses, metro, rails, and ferries, to facilitate seamless user experience. The solution should provide:

1. Route Optimization: The system should be capable of efficient dynamic scheduling of trips and frequency, taking into account factors such as road conditions, population, rush hours traffic, …etc.
2. Load Balancing and Consolidation: The system should optimize load distribution across available transportation modes to reduce costs, minimize congestion, and maximize resource utilization.
3. Reporting and Analytics: The system should provide stakeholders with access to real-time and historical data, allowing them to analyze trends, monitor performance, and make data-driven decisions.
4. Environmental Impact Assessment: The system should estimate the environmental impact of each transportation decision, such as CO2 emissions, noise pollution, and energy consumption, to promote sustainable practices.
5. Security and Compliance: The system should ensure data privacy and security, as well as compliance with relevant regulations and industry standards.