

Assignment: Design a Cashierless Store Application with Edge Computing and Fog Data Centers

Introduction: In the lecture, we have discussed the edge computing and how the edge facilities can be organized in a hierarchy. An example of the self-driving car is discussed along with Amazon Go and Amazon Warehouses. In this assignment, you are asked to make a *high-level* design of a Cashierless store application (like Amazon Go) to work on the edge. The design must answer 2 important questions:

- What parts of the application could run on which level of the edge facilities hierarchy. And why?

Objective:

The objective of this assignment is to design a cashierless store application (*high-level*) that leverages edge computing and fog data centers to provide a seamless shopping experience for customers. The application should incorporate the specified requirements and demonstrate an understanding of the architectural considerations, and data management strategies aspects related to edge computing and fog data centers.

General Requirements of Cashierless store:

1. Customer Experience:

- a. Self-checkout mechanism that allows customers to enter the store, select products, and complete the checkout process without cashier assistance.
- b. Computer vision to accurately identify and track products as customers add them to their carts.
- c. Provide customers with digital receipts via email or a mobile app after completing a purchase.

2. Edge Computing and Fog Data Centers:

- a. Design a high-level distributed architecture that includes edge and fog data centers/computers.
- d. Implement fault-tolerant mechanisms to handle sensor failures and ensure continuous operation of the cashierless store.
- d. Optimize data processing latency by performing real-time computations and decision-making at the edge, minimizing reliance on cloud communication.

3. Inventory Management:

- a. A real-time inventory tracking system that accurately reflects product additions and removals.
- b. Automated notifications or alerts to notify store personnel when specific products reach predefined low stock levels, facilitating timely restocking.
- c. Provide customers with a mobile app or store navigation system that offers real-time information about product locations within the store.

Instructions:

1. Familiarize yourself with the concept of edge computing and fog data centers, and understand their advantages and challenges in the context of a cashierless store application.
2. Based on the provided requirements, design a high-level architecture for the cashierless store application,
 - Which parts of the application can run on which level of the edge hierarchy.
 - What are the data to be processed at each level.
3. Discuss failover considerations and propose mechanisms for handling the failure of any device (camera, sensor, etc.)
4. Present your design in the form of a report or presentation that explains your design, including diagrams, and any other visual aids that help illustrate your design decisions.
5. You need to specify the main components only in the design. You are not asked to put the design details for each component (e.g., you might specify a component for handling picking item from shelf, a component for a cart, etc.). No more fine details about each component.
 - The same way we have discussed for the self-driving car example (collision system runs locally, etc.)

Submission Guidelines:

Submit your design report or presentation, including all relevant explanations and diagrams on moodle by maximum 27-12-2023

Evaluation Criteria:

Your design will be evaluated based on the following criteria:

1. Adherence to the specified requirements
2. Clarity and completeness of the design
3. Understanding of edge computing and fog data centers
4. Fault tolerance considerations

Additional resources:

<https://www.youtube.com/watch?v=j9iNEhn4NmE>

Note: Please ensure that your design is original and does not violate any academic integrity policies. Properly cite and reference any external sources used in your research.

Good luck with your assignment!

Dr. Mohamed ElGazzar