



POLITECNICO
MILANO 1863

CLup

Requirement Analysis and Specification Document

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1 Introduction

1.1 Purpose

The coronavirus emergency has put a strain on society on many levels, in particular, grocery shopping can become a challenge in the presence of such strict rules: supermarkets need to restrict access to their stores to avoid having crowds inside and long lines outside. The goal of this project is to develop an easy-to-use application that, on the one side, allows store managers to regulate the influx of people in the building and, on the other side, saves people from having to line up and stand outside of stores for hours on end.

The application will allow customers to “line up” (i.e., retrieve a number) from their home, and then wait until their number is called (or is close to being called) to approach the store. In addition, the application could be used to generate QR codes that would be scanned upon entering the store, thus allowing store managers to monitor entrances.

1. CLup should allow customers to queue up remotely and in loco (fallback) so that they don't need to form a physical line
2. CLup should allow store owners to allow store managers to regulate the input and output streams of customers in the building
3. CLup should provide the customer with a reasonably precise estimate of waiting time
4. CLup should alert the customers when it is time to get to the shop taking into account travel time
5. CLup should allow customers to book future visits to stores
6. CLup should allow customers to specify estimated visit duration and desired objects in order to provide a better guess
7. CLup should be able to infer an approximate duration of the visit from an analysis of the previous one to plan visits and manage the queue in a finer way

1.2 Scope

The system to be allows to avoid creating queues in front of stores. This is accomplished by enabling the users to queue up remotely. Moreover, the shop owners can oversee customers entering and exiting stores.

The system offers the following functionalities:

- it allows customers to line up remotely
- it identifies a customer
- it allows identified customers whose position in queue allows it to enter and exit the store
- it schedules customers in order to minimize overcrowding inside and outside of the store
- it alerts customers when they should head to the store
- it allows customers to queue up on the spot
- it allows customers to book a visit and optionally specify duration and desired categories of products
- it uses statistics build on entrance and exit data to better evaluate duration of visits

1.2.1 World Phenomena

1. Customer reaches the store
2. Customer enters or exits shop
3. Store owner keeps in check influx of customers in building
4. Customer buys products

1.2.2 Shared Phenomena

1. Customer queues up
2. Customer is identified in order to allow entrance/exit from store
3. Customer is allocated a time slot and is alerted when his turn is close
4. Customer books a visit to a store

1.2.3 World Phenomena

1.3 Definitions, Acronyms, Abbreviations

1.3.1 Definitions

Ticket	Virtual or physical artifact used to identify the position of a customer in a queue
Identification	Customer is identified when he receives a ticket (be it virtual or physical) and he is inserted in the queue
Reservation	A place in the queue
Enqueued	A customer is enqueued when he has provided the system with a mean of identification and requested a reservation
Authorized	A customer is authorized when he has been enqueued and is allowed temporary access access the store
Occupation	Number of customers present in the store

1.3.2 Acronyms

RASD	Requirement Analysis and Specification Document
GPS	Global Positioning System
S2B	Software to be
UI	User Interface

1.3.3 Abbreviations

Gn	Goal number n
Rn	Requirement number n
Dn	Domain Assumption number n

1.4 Revision history

Not yet defined.

1.5 Reference Documents

1. IEEE Std 830-1998 Recommended Practice for Software Requirements Specifications
2. Specification Document: R&DD Assignment A.Y. 2020/2021

1.6 Document Structure

- Chapter 1: gives an introduction about the project, describing the purpose of the system informally and defining its scope, its main goals, world and shared phenomena. Moreover this section contains specifications such as the definitions, acronyms, abbreviation, revision history of the document and the references.
- Chapter 2: contains the overall description of the project, with a more in-depth look at its functionalities. Here are identified the main actors involved in the application's usage lifecycle, some scenarios that point out the major features of the S2B, and all the necessary domain assumptions, dependencies and constraints. This section also provides a class diagram, which aid to better understand the general structure of the project, and some state diagrams, to make the evolution of the crucial objects clear.
- Chapter 3: This section contains the core of the document: first it presents the interface requirement including user, hardware, software and communication interfaces. Then it offers the specification and the description of all the functional requirements necessary in order to reach the goals; is also provided a list of use cases, with their corresponding sequence diagrams and their mapping on the requirements, as long as some scenarios, useful to identify specific cases in which the application can be utilised. Finally non-functional requirements are defined, including performance, design and the software systems attributes.
- Chapter 4: includes the alloy code and the corresponding metamodels generated from it, in order to show how the project has been modeled and represented through the language.
- Chapter 5: shows the effort which each member of the group spent working on the project.
- Chapter 6: includes the reference documents.

2 Overall Description

2.1 Product perspective

The S2B will be used by two kinds of users: customers store owner.

2.1.1 Customer

The customer can create reservations for a desired store: such reservation is then inserted into a queue. This queue is managed in order to avoid overcrowding. To achieve this, statistics about visits' durations are exploited, taking also into account information that customers may provide (e.g. which department of the store they want to visit).

There are multiple types of reservations that can be requested:

1. Immediate reservation: the customer wants to queue up immediately to a store. He/she is also provided with an estimation of the time he has to wait before his/her turn.
2. Future reservation: the customer wants to book a future visit at a desired time and store.
When creating the reservation the customer can specify how long he/she intends to stay and which departments of the market he/she plans to go to, in order to provide a better plan. If he/she does not specify the duration the system can infer it using some statistic built on his/her previous visits. Then the customer will be provided with the actual time he will be able to access the store (considering the bookings from other customers).
3. On premise reservation: the customer is allowed to enqueue directly at the store. Each of them will provide a system to print tickets so that those who do not have access to the required technology for the previous options can still line up.
These tickets contain a reservation number and an estimation of the waiting time before being able to enter.

Customers who requested an immediate or a future reservation receive an alert when they need to depart to reach the store. This alert is based on the location of the customer, so that the time needed to reach the store is taken into account.

Moreover immediate and future reservations can be deleted by who created them.

2.1.2 Store owner

The store owner can set the maximum occupation threshold for each of his stores, to avoid overcrowding. He/she can also monitor the number of customers inside at any time and visualize statistics about the flow of clients and department occupation.

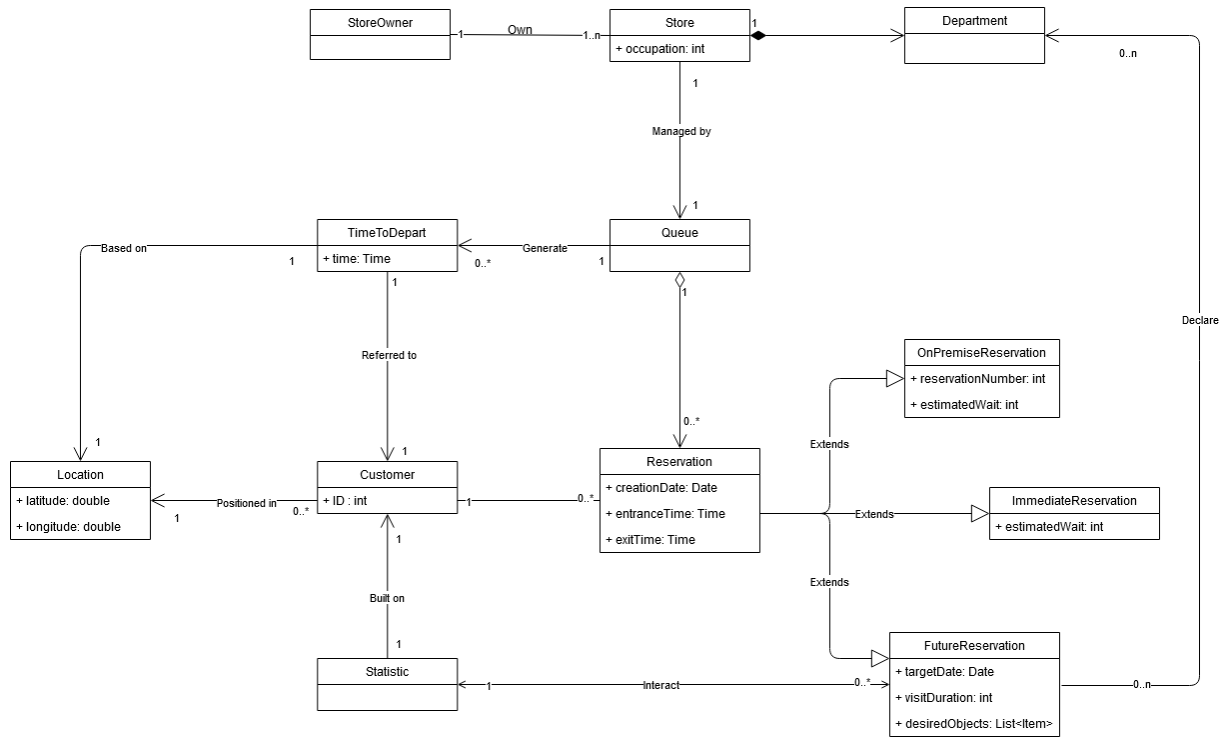


Figure 1: Class Diagram.

2.1.3 State charts

Here we show the main processes that the system will manage, and the states in which the system will find itself.

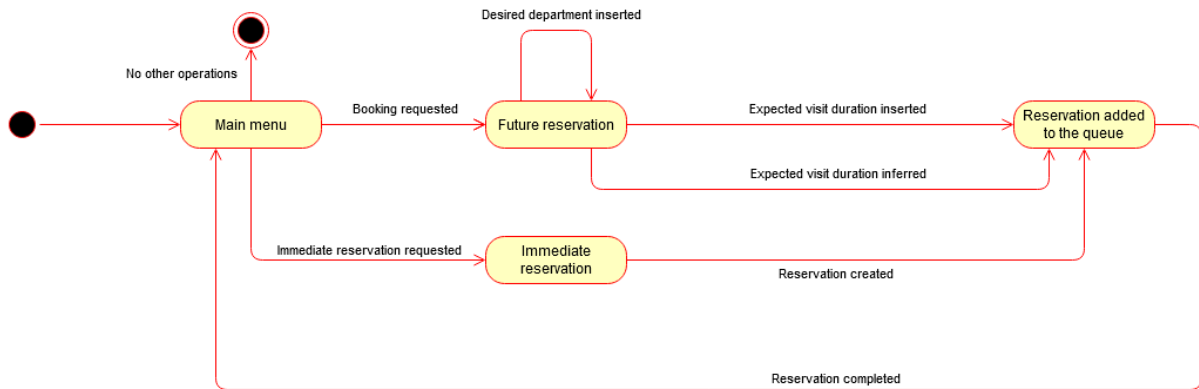


Figure 2: State Diagram 1: Creation of a reservation.

The figure above illustrates how the customer creates a reservation (virtual customer). The customer accesses the main menu. From there he/she can request an immediate reservation or a future reservation. If he/she requests an immediate reservation, it is created and the process terminates. If he/she requires a future reservation he can add the departments he/she intends to visit, and how much time he/she is going to spend at the store. Then the reservation is created and the process terminates.

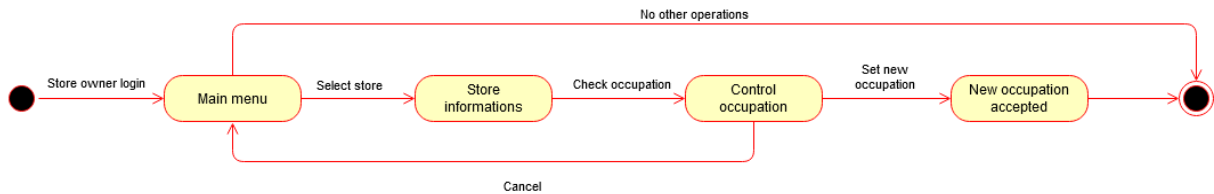


Figure 3: State Diagram 2: Store owner sets occupation.

The figure above illustrates how the store owner sets the maximum occupation of one of his stores. The store owner logs in and is provided a main menu. He/she selects one of his stores, and is presented with the current maximum occupation of his selected store. He can change it to a value to his liking, or go back to the main menu.

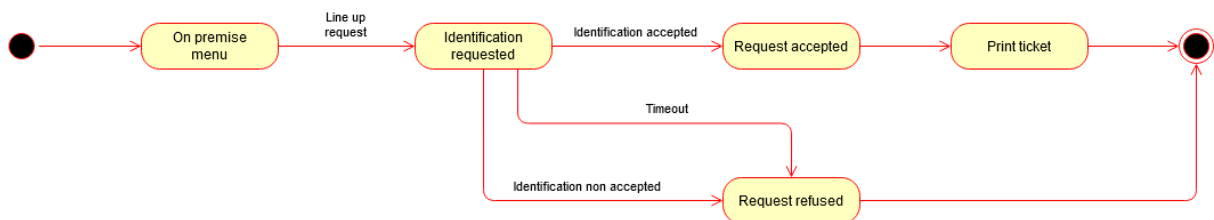


Figure 4: State Diagram 3: On premise creation of a reservation.

The figure above illustrates how a customer can queue up on premise (physical customer). The customer is presented with an on premise main menu. From there he/she can request to queue up (create a reservation) immediately. He will be prompted to identify himself (e.g. social security card). Once identified the customer will be provided a ticket with a number that represents his position in queue and an estimate of the waiting time.

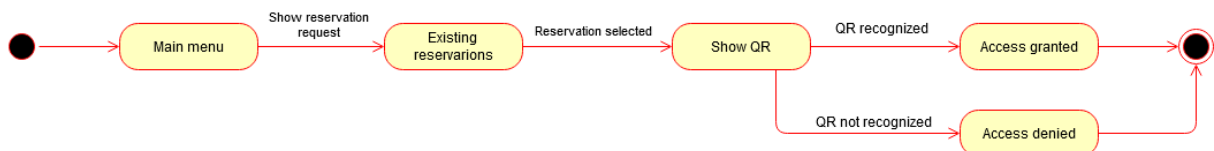


Figure 5: State Diagram 3: Customer enters a store.

The figure above illustrates how a customer who is authorized can access the store. At the entrance of his/her store of choice he is enabled to demonstrate his authorization. Once he/she does, he is allowed to enter the store.

2.2 Product functions

We describe here functions that the S2B will support.

1. Customers can queue up virtually or physically at one of the stores registered to the service.
2. Customers can access the desired store when its population reaches acceptable levels.
3. Customers that queued up virtually can be notified when it is time for them to depart to reach the store.
4. Store owners can monitor the population in each of their stores.
5. Store owners can define the maximum population of each of their stores.
6. Store owners can register stores to the system.

2.3 User characteristics

1. **Customers:** a physical person that needs to access any of the stores registered to the system. The customers belong to all demographics, thus the need for a user-friendly interface for both virtual and physical customers. The customer needs a reasonably precise estimate of waiting time and time to get to the store.
2. **Store owners:** a physical or legal person that owns any number of stores and needs to enable customer access through a queue system.

2.4 Assumptions, dependencies and constraints

2.4.1 Domain Assumptions

1. The stores have means to allow entrance or exit to customers that are authorized (e.g. QR/NFC).
2. Outside stores a device can identify customers and print tickets.
3. When provided, user location has maximum error of 5 meters.
4. There is no way for a customer to enter a store except from entrance and exit.
5. Each virtual and physical customer has means of identification unique to that user (e.g, telephone number, social security card).

3 Specific Requirements

3.1 External interface requirements

3.1.1 User interfaces

There are two categories of users that have different interface requirements:

- **Customers**

Customers belong to all demographics so a user friendly interface is needed. The customer is presented with a main menu which allows him/her to:

- line up immediately
- book a visit
- view and delete existing reservations

The customer will receive a notification when it is time for him/her to depart to reach the shop.

- **Store owners**

The store owner is presented with a main menu from which he/she can:

- register a store to the system
- delete a store from the system
- view and edit occupation for currently registered stores

3.1.2 Hardware interfaces

The S2B requires the following hardware interfaces:

1. **Computer or smartphone**

Users will need a computer or a smartphone to access the system's services which are provided via an application (only for smartphone owners) and a web application. Only users with an application will be able to receive notifications that alert them when it is time for them to depart and reach the store.

2. **Turnstiles**

Turnstiles allow authorized customers to enter or exit the store by providing a means of identification. (i.e. QR, NFC)

3. **Ticket printer**

The ticket printers located outside stores allow potential customers to queue up on premise provided that they identify themselves (e.g. social security card).

3.1.3 Software interfaces

The system uses a public API to locate the customer and provide him/her with notifications about the time he will need to depart to reach the store.

3.1.4 Communication interfaces

Customers can access the system through a working internet connection.

4 Formal Analysis Using Alloy

Organize this section according to the rules defined in the project description.

5 Effort Spent

Provide here information about how much effort each group member spent in working at this document. We would appreciate details here.

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1. Writing goals 3
2. UML class diagram 4
3. Product perspective 3
4. State charts, External interface requirements 3

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1. Writing goals 3
2. UML class diagram 3
3. Product perspective 3
4. Product functions, user characteristics, domain assumptions 3
5. State charts, External interface requirements 3

References

- [1] S. Bernardi, J. Merseguer, and D. C. Petriu. A dependability profile within MARTE. *Software and Systems Modeling*, 10(3):313–336, 2011.