Politecnico di Milano
Dipartimento di Elettronica, Informazione e Bioingegneria

CLup
Requirements Analysis and Specification Document

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Contents

1. Introduction

1.1 Purpose

During the ongoing COVID-19 pandemic, social distancing has proven to be a valuable tool to reduce the diffusion of the virus among the population. To enforce this kind of behaviour, governments around the world adopted strict lockdown policies, allowing people out of their homes only to carry out essential tasks. Grocery shopping has proven to be a challenging situation to regulate, due to the need for both restricting access to the shops and avoiding the formation of crowded queues outside of them.

To maximize the accesses to the store while preserving a safe environment and to ease visit planning, the store customer should be provided with a way to express preferences for a time slot and to indicate the approximate duration of his visit. Moreover, the accesses across different stores and day or time ranges should be balanced by proactively suggesting possible alternatives. Overall, each process should be easy to use to include all demographics.

The goal of the following document is to provide a comprehensive description of requirements and specification for the software-to-be under analysis. Relevant use cases and models will be addressed through the use of natural language, UML, and Alloy. Choices made regarding the interpretation, the problem under analysis and the related software-to-be will be clearly stated by the creators of this document, along with their rationale.

1.1.1 Goals

ID	Goal
G1	The number of people in the store should be compliant with the country's regulation.
G2	The distance between people in the store should be compliant with the country's regulation.
G3	Store managers should be able to regulate the influx of customers to the store.
G4	Every customer should be able to access a store.
G5	Every customer should be able to access a store in a first come, first served order.
G6	The distance between people in proximity to the store should be compliant with the country's regulation.
G7	Customers should be evenly distributed across the stores adopting the system.
G8	Customers should be evenly distributed across the available time slots.
G9	Customers should access a store in an acceptable time slot.
G10	Customers should access a store at an acceptable location.
G11	If available, customers should access the store in the preferred time slot.
G12	Customers should access the store at the preferred location.

1.2 Scope

1.2.1 Product

CLup is a system that allows to handle access to supermarkets when the flux of people is restricted. In particular, it allows customers to line-up remotely (i.e., without being physically in a line outside the supermarket) and suggests them the right time to go to the supermarket without having to form a queue outside.

CLup allows customers either to request access to the supermarket as soon as possible, or to book in advance an access to the supermarket at a given slot of date and time. In both cases, the system aims at preventing overcrowding in each area of the building. Access to the supermarket is granted only when using the system so that CLup can actively monitor the number of people inside the building.

Customers will be allowed to enter the store from the time they chose when requesting to line up, but no later than a centrally determined delay after the chosen time, after which their line up request will expire.

If many people are in a queue for the same access slot, CLup gives the customers possible alternatives about slots or supermarket that are less crowded. Moreover, upon customer request, it can proactively inform them if there are available slots in a given day or time range.

The main interface between CLup and the user is assumed to be an IT device with an Internet connection. However, since not all people may have access to such technologies, the system can be used, with limited functionalities, just through a standard telephone line or in presence.

The system is completed by an administrational dashboard that allows store managers to monitor the accesses to the supermarkets in real-time and to manage the queuing parameters, such as the maximum number of people allowed in the building at the same time.

1.2.2 World and Shared phenomena

1.2.2.1 World phenomena

ID	Phenomenon
WP1	The customer needs to go grocery shopping.
WP2	The customer arrives at the supermarket.
WP3	The customer asks to line up to a store assistant (fallback method).
WP4	The customer leaves the supermarket.
WP5	The local authority asks the store manager to report how many people are inside the building.
WP6	The local authority asks the store manager to increase or decrease the maximum number of people allowed inside the building.

1.2.2.2 Shared phenomena - controlled by the World

ID	Phenomenon
SP1	The customer asks the system to line up and enter the supermarket as soon as possible through an IT device.
SP2	The customer asks the system to book an entrance at the supermarket at a given date and time through an IT device.
SP3	The customer asks the system to line up and enter the supermarket as soon as possible through a standard telephone line.
SP4	The customer asks the system to book an entrance at the supermarket at a given date and time through a standard telephone line.
SP5	The store assistant asks the system to line up a customer, to let them enter the supermarket as soon as possible.
SP6	The customer asks the system to print the receipt of a request made by telephone with an on-site device.
SP7	The customer informs the system on the estimated duration of the visit to the supermarket.
SP8	The customer informs the system on the categories of products they intend to buy.
SP9	The customer scans the QR code receipt at the entrance of the supermarket.
SP10	The customer scans the QR code receipt at the exit of the supermarket.
SP11	The store manager queries the system for the number of people inside the building.
SP12	The store manager informs the system on the maximum number of people allowed inside the building.

1.2.2.3 Shared phenomena - controlled by the Machine

ID	Phenomenon
SP13	The system shows the user a QR code as a receipt of a request performed through an IT device.
SP14	The system prints through an on-site device a QR code as a receipt of a request performed through a standard telephone line.
SP15	The system prints through an on-site device a QR code as a receipt of a request performed through the on-site device itself.
SP16	The system informs the customer that it's time to go to the supermarket to take advantage of the requested slot.
SP17	The system allows a customer to enter the supermarket.
SP18	The system gives the customer suggestions on less crowded slots or supermarkets.
SP19	The system informs the customer that a specific time slot in a range they chose in advance is available

1.3 Definitions, acronyms, abbreviations

1.3.1 Definitions

Dashboard A panel usually containing instruments and controls.

Demographic The statistical characteristics of human populations (such as age or income) used especially to identify markets.

Fallback method A method used as reserve.

Lockdown policy A lockdown policy is a requirement for people to stay where they are, usually due to specific risks to themselves or to others if they can move freely.

Proxy Authority given to a person to act for someone else

Push notification A message that is "pushed" from the backend server or from the application to user interface, usually announced with sound and/or vibration of the device.

Receipt scanner In the context of the present system, a receipt scanner is an optical device that can read customers' line up receipts.

Social distancing In public health, social distancing, also called physical distancing, is a set of non-pharmaceutical interventions or measures intended to prevent the spread of a contagious disease by maintaining a physical distance between people and reducing the number of times people come into close contact with each other.

1.3.2 Acronyms

CLup Customers Line-up

COVID-19 COronaVIrus Disease 2019.

DA Domain Assumption

G Goal.

IT device Information Technology device.

QR code Quick Response code.

R Requirement.

RASD Requirements Analysis and Specification Document.

SP Shared Phenomenon.

UML Unified Modeling Language.

WP World Phenomenon.

Version	Date	Notes
V1.0	TBD	Initial release.

1.3.3   Abbreviations

1.4   Revision history

1.5   Reference documents

- **Alloy documentation**

- **R&DD Assignment AY 2020-2021**

- **The world and the machine** by M. Jackson

- **UML documentation**

2. Overall description

2.1 Product perspective

2.1.1 Class diagram

A UML class diagram describing the main entities involved in the system follows. Customers use the system to line up in the queue of a store and obtain a line up receipt, which will grant them a visit to the store. Each store belongs to a given chain of stores. Moreover, each store can be internally divided in departments, containing different categories of purchasable items. When the customers line up, they can specify the categories of items they intend to buy. Finally, the system knows the locations of the customers and of the stores.

The line up receipt is represented by a QR code for the customers that interact with the system with an IT device.

If the customers interact with the system using a standard telephone line, they are given a numeric code as a representation of the line up receipt, which they will be able to convert to a printed QR code line up receipt thanks to the store assistants outside of the store.

The customers who interact with the system in presence request the printed QR code line up receipt directly to the store assistants outside of the store.
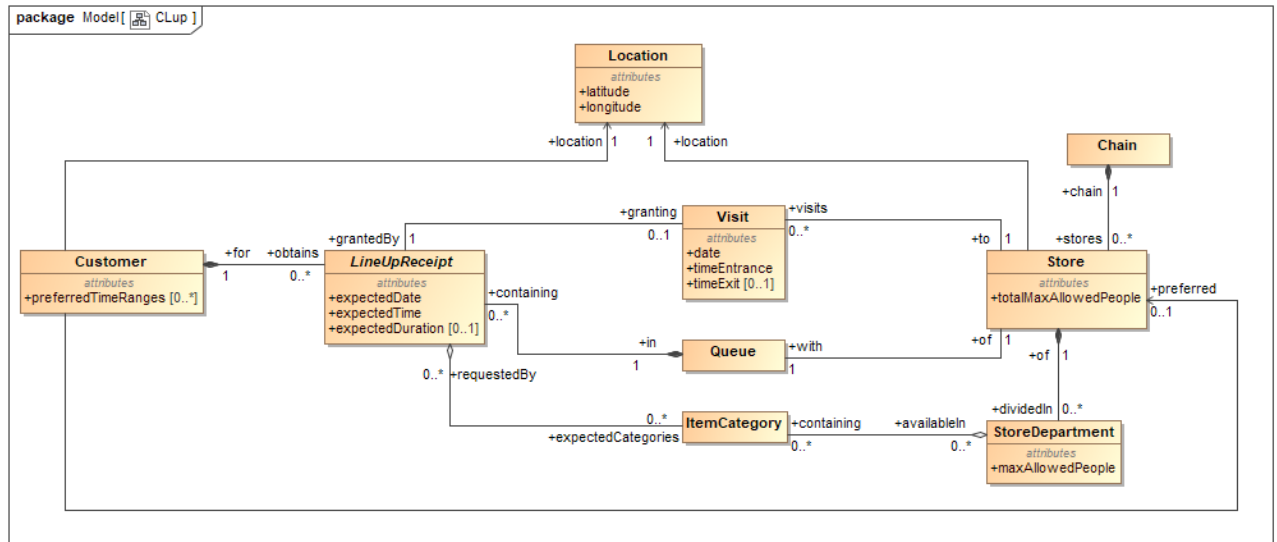

Figure 2.1: The class diagram of CLup's application domain.

2.1.2   State chart diagrams

The internal state of the main entities of the domain is better defined in the following UML state diagrams.
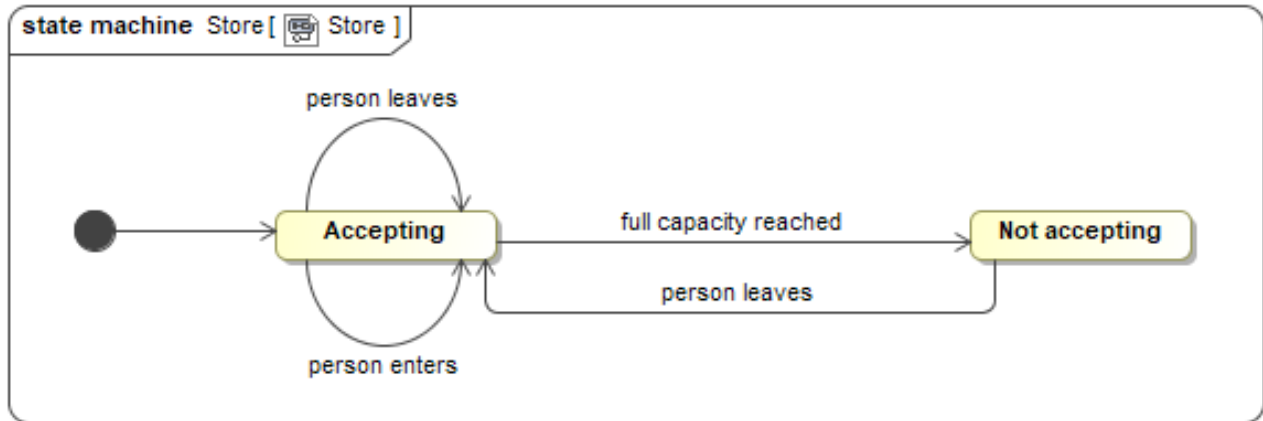

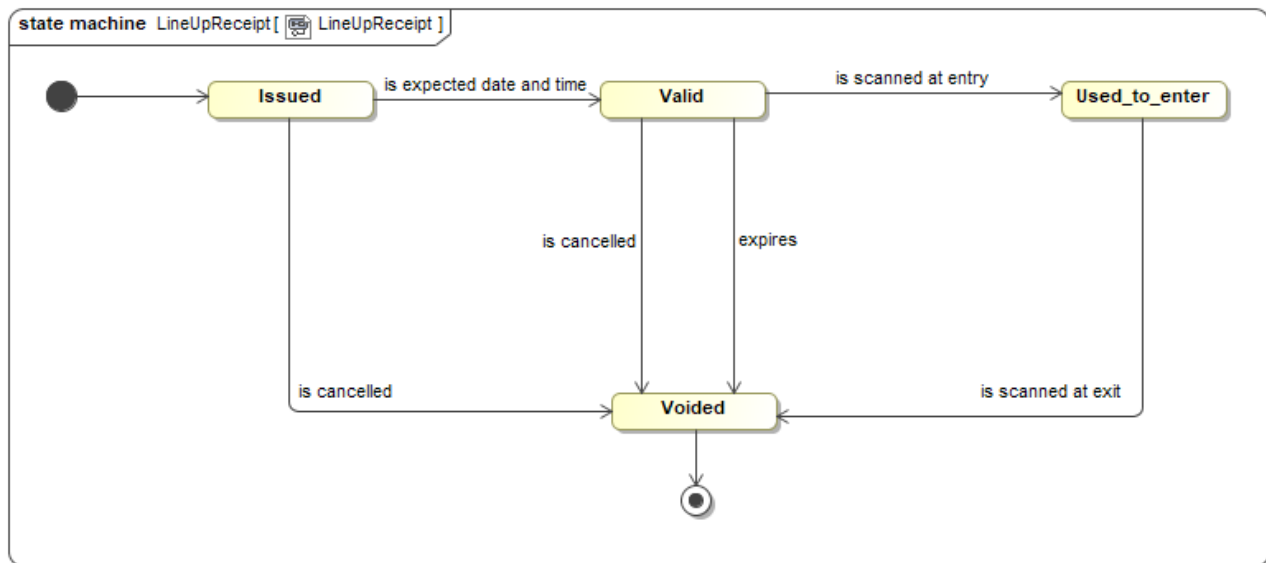Figure 2.2: Statechart of a store in the application domain.

Figure 2.3: Statechart of a lineup receipt in the application domain.

2.2   Product functions

The following functionalities must be provided by the system in order to satisfy the previously stated goals:

ID	Requirement
R1	The system must grant access to the store if and only if the desired safety standard are respected.
R2	The system must allow store managers to set the desired safety standards.
R3	The system must allow every user to line up to access the store.
R4	The system must allow store assistants to act as proxies of multiple users.
R5	If a user owns an IT device, the system must allow them to reserve a place in a queue in advance for a given day and time.
R6	The system must estimate the duration of a visit by a user who reserved a place.
R7	The system must estimate the departments visited by a user who reserved a place.
R8	In case of reservation, the system must grant access to the user before the ticket expires.
R9	If the number of people accessing the store in a given time and date is estimated to exceed to the desired security standard, the system must suggest alternative time slots and dates or an alternative stores to the user.
R10	The system must suggest a store reachable by the user.
R11	The system must suggest a time and date compatible with the user's schedule.

2.3 User characteristics

The following users are addressed by the application:

- Supermarket's customers: people of any age, gender, nationality, and education interested in accessing the store. This includes people with physical or visual disabilities.

- Store managers: employees whose responsibility is to monitor and regulate the flow of people inside the supermarket.

- Store assistants: employees in charge of releasing the queue ticket to customers requesting them on-site.

- Store cashiers: employees in charge of scanning tickets at the time of checkout to register exits of the customers.

2.4 Assumptions, dependencies and constraints

2.4.1 Domain assumptions

ID	Domain assumption
DA1	The number of people who can access the store is either decided by the authorities, or by the manager, respecting the law.
DA2	Customers won't try to bypass the store access control measures.
DA3	The population is evenly distributed on the territory among store locations.
DA4	All customers who enter the supermarket check out with a human or automatic cashier.
DA5	All customers only visit the areas of the supermarket containing the item categories they declared when reserving their entrance through the system.
DA6	Customers will not form crowds outside of the store, if the queue is moderately long.
DA7	Few people do not have an IT device with support for Internet connectivity or a standard telephone line.

3.   Specific requirements

3.1   External interface requirements

3.1.1   User interfaces

3.1.1.1   User interfaces for the customers

User interfaces for the customers should be easy to use, thus taking into account the needs of people of all ages and possibly with disabilities.

All the customers need to interact with receipt scanners at the entrance of the stores to get access rights. Then, depending on the channel that customers want to use to obtain a line-up receipt, they may need to interact with additional user interfaces, as described in the following paragraphs.

User interfaces for the customers using IT devices   The following mockups can be navigated with elementary interactivity at this [link](https://app.moqups.com/GnQbxBHNrI/view/page/ad64222d5?ui=0).
// TODO: ADD MOCKUPS HERE

User interfaces for the customers using a standard telephone line   Customers using a standard telephone line are allowed to use the system, although with limited functionality. Customers can interact with the system by calling a dedicated telephone number. An interactive system picks up the call, receives input from the customer through speech recognition and DTMF tones recognition, and replies to the customer through speech synthetization.

User interfaces for the customers using the system in presence (fallback method)   Customers who cannot use one of the other methods described before can interact with the system, with limited functionality, thanks to store assistants outside of the stores. The assistants act as a proxy to the system for the customers, so no specific user interface is needed for these customers.

3.1.1.2   User interfaces for the store assistants

Store assistants can interact with the system to generate line up tickets for the customers.
// TODO: ADD MOCKUPS HERE

3.1.1.3   User interfaces for the store managers

Store managers can interact with the system to monitor the number of people inside the stores and to define limitations on the maximum number of people allowed in each department of the store.
// TODO: ADD MOCKUPS HERE

3.1.2 Hardware interfaces

Customers who want to interact with the system with full functionality need to have an IT device with support for Internet connectivity (mandatory) and able to provide geolocation information (optional). Customers who do not satisfy this requirement but still want to interact with the system remotely need to have any kind of devices that is able to place phone calls to a standard telephone number.

Store assistants and store managers need to have an IT device with support for Internet connectivity. Store assistants systems need to interact with printers placed outside of the stores to print line up receipts for the customers that initially used a telephone line to interact with the system or for the ones who chose to use the system in presence, as a fallback.

Moreover, the system interacts with receipt scanners with support for Internet connectivity. Such devices will be placed at the entrance of the stores and they will unlock access control devices to let the customers enter.

Finally, the system interacts with receipt scanners with support for Internet connectivity placed at the cash counters (both automatic and human-managed) to register the end of a visit to the store.

3.1.3 Software interfaces

The IT device used by customers who want to interact with the system with full functionality, by store assistants and by store managers need to either have an Internet browser with HTML5 capabilities installed, or support the installation of native apps for the supported platforms (Android, iOS). Depending on the requirement which is satisfied, the system will use browser APIs or system APIs to interact with the user upon user request or with push notifications.

The system interacts with the software interfaces of the automatic phone call provider thanks to which customers can interact via a standard telephone line.

3.1.4 Communication interfaces

Customers who want to interact with the system with full functionality, store assistants, store managers and the devices that scan the customers' line up receipt use any kind of Internet connection to communicate with the system. Devices of customers who want to interact with the system with full functionality which are able to provide geolocation information use such system (GPS or equivalent) to retrieve the location. Customers who want to interact with the system remotely but do not have a suitable IT device use a standard telephone line to communicate with the system.

The system uses an Internet connection to communicate with the automatic phone call provider thanks to which customers can interact via a standard telephone line.

4. Effort spent

4.1   Andrea Riva

Date	Effort spent (h)	Notes
17/10/2020	0.5	Introduction briefing
09/11/2020	3.0	Scope
14/11/2020	1.0	Harmonization and task appointing meeting
14/11/2020	1.5	Initial version of class diagrams
18/11/2020	0.5	Reviews
18/11/2020	1.5	External interfaces
21/11/2020	1.0	Harmonization and task appointing meeting
21/11/2020	2.0	Mockups
22/11/2020	0.5	Fixes and general improvements

4.2   Alessandro Sanvito

Date	Effort spent (h)	Notes
10/10/2020	1.0	Project set-up
17/10/2020	0.5	Introduction briefing
17/10/2020	0.5	Purpose description
10/11/2020	0.5	Scope review
11/11/2020	2.0	Purpose description
14/11/2020	1.0	Harmonization and task appointing meeting
16/11/2020	1.5	Introduction complete and store state machine
18/11/2020	0.5	Domain assumptions review
21/11/2020	1.0	Harmonization and task appointing meeting
22/11/2020	1.0	Product functions definition
22/11/2020	0.5	PR review and insertion of images in product perspective

4.3   Luca Vecchio

Date	Effort spent (h)	Notes
17/10/2020	0.5	Introduction briefing
11/11/2020	0.5	PR review
11/11/2020	0.5	User characteristics
14/11/2020	1.0	Harmonization and task appointing meeting
21/11/2020	1.0	Harmonization and task appointing meeting