RASD

Requirements Analysis and Specification Document

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CONTENTS

1 INTRODUCTION

1.1 Purpose

The purpose of the project CLup (Customer Line-up) is to develop a digital system of line up that saves people from having to stand outside of stores for hours, avoids crowds inside the store, and, more in general, allows to regulate the influx of people in the stores.

The idea is to create a digital version of the traditional mechanism of lining up that is easy to use by everyone. In this way, the system would help to deal with the strict rules imposed by the government due to the global pandemic.

The system should give customers the possibility to line up from their home and approach to store only when their number is close to being called. This mechanism should avoid the situation in which the customers wait for their shift in the proximity of the store that is not an acceptable scenario in a lockdown situation.

G.1	Allows to regulate the influx of people that enter the building.
G.2	Avoids that customers must line up and wait outside of stores for hours.
G.3	Crowding is avoided in all forms inside the shop.
G.4	Everyone must be able to shop, even people who do not have access to the required technology.
G.5	Smart managing of the lining up and booking with a digital system.

1.2 Scope

The software should represent a digital alternative to the situation in which people retrieve a physical number that gives their position in the queue when they want to enter a store.

C-Lup should provide three main features:

- **Lining up**: allows customers to line up from their home avoiding crowds outside the stores. It should include tools to regulate the influx of people into the store and a notification system that alerts people when their number is close to being called. These alerts should consider the time customers need to get to the shop from the place they currently are and should be based on precise estimation of the waiting time. Moreover, C-Lup must provide effective fallback options for people who do not have access to the required technology. Lastly, the system should consent to indicate the categories of items that the customers guess to buy. This would allow to menage better space into the store and optimize more efficiently the number of people not only in the whole store but also in each sector of the supermarket.

- **Booking**: allows customers to book a visit to the supermarket. Since the time that it takes to visit a supermarket is not uniform, the system should give to user the possibility to specify an estimation of the duration of the visit. Alternatively, it might infer this information analysing the previous visits, if any. Also, in this case, the customers should specify the sectors of the supermarket that they think to visit.
- **Suggestions**: suggests different time slots for visiting the store (also on different days) to deal better with the restriction in the number of people inside the store. Alternatively, the system should propose to the customers other available supermarkets and alerts them in case a new time slot becomes available (e.g. after the deleting of a booking by another customer).

The customer that wants to use the service must be registered. Thanks to this, the system would be able to track the lining up, the booking, and the duration of the previous visits and use this information to manage better the influx of people and estimates with acceptable accuracy the waiting time.

1.2.1 World Phenomena

W.1	Limitation on the number of entrances into buildings.
W.2	Distance of at least one meter between people.
W.3	Prohibition of gathering and long lines near the groceries.
W.4	The required technology is not accessible to everyone.
W.5	Variable visit time inside the shops.

1.2.2 Shared Phenomena

S.1	Regulation of the influx of people in the shop.
S.2	Management of the lines outside of stores.
S.3	*Line up* at the store from a smartphone.
S.4	Monitoring of the entrances by store managers.
S.5	Estimation of the waiting time.
S.6	Notification that alerts customers when their shift will begin shortly.
S.7	*Line up* for people that do not have access to the required technology.
S.8	Booking a visit to the supermarket.
S.9	Estimation of visit time inside the shops.

S.10	Suggestion of different stores of different chains.
S.11	Suggestion of different time slots to visit the store.
S.12	Periodic notification of available time slots in a day/time range.

1.3   Definitions, Acronyms, Abbreviations

1.3.1 Definitions

Thematic sectors	Areas of the store that sell a specific macro-category of products. They are food, electronic, clothing, and care products.
Time slot	Period or day that can be chosen for a booking by the customers.
Store data	Data about the store like the number of people allowed in each thematic sector, opening and closing times, address, name, and photo.
Reservation	A word that might indicate either a booking or a lining up in a specific store.
Active reservation	
Store manager	Manager, cashier, or employee of a store.

1.3.2 Acronyms

CLup	Customer Line-up
RASD	

1.3.3 Abbreviations

Wn	World phenomena n-th
Sn	Shared phenomena n-th
Gn	Goal n-th
Rn	Requirement n-th
UI	User interface

1.4   Revision history

DATE	DESCRIPTION
31/10/2020	First version and goals definition.
07/11/2020	World and shared phenomena definition.
25/11/2020	Mock-ups, textual descriptions, definitions, acronyms, and abbreviations.
29/11/2020	Mapping between goals, requirements, and domain assumptions. General improvement.
02/12/2020	Adding Product Functions and Product Perspective descriptions.

1.5   Reference Documents

- *Requirement Engineering and Design Project: goal, schedule, and rules*
- *I&T assignment goal, schedule, and rules*
- Slides of the course *Software Engineering 2*

1.6   Document Structure

The document is composed of six chapters. They are the following:

- **Chapter 1**: provides an introduction to the purposes and the whole scenario of the software. First, it includes the general description of the system and the goals. Then, there is a sufficiently detailed specification of the main features that the system should provide and the analysis of the world and shared phenomena. Lastly, it includes the list of abbreviations, acronyms, and definitions used in the document, the revision history, and the reference documents.
- **Chapter 2**:
- **Chapter 3**:
- **Chapter 4**:
- **Chapter 5**: shows the amount of time that each member has spent to produce the document.

- **Chapter 6**: specifies the reference documents and online resources used during the production of this document.

R.1	The system generates a single QR code to enter and exit the store for each booking or lining up.
R.2	The system allows customers to book a visit to the supermarket.
R.3	The system provides customers a precise estimation of the waiting time.
R.4	The system uses the customers' current position to estimate the waiting time.
R.5	The system alerts the customers before their shift according to the geolocation information.
R.6	The system allows people (who do not have access to the required technology) digitally line up directly when they are at the store.
R.7	The system suggests alternative time slots for visiting the store when the desired one is not available.
R.8	The system suggests alternative stores when the desired one is not available.
R.9	The system allows customers to insert the approximate expected duration of the visit.
R.10	The system infers customers' expected duration of the visit based on an analysis of the previous visits.
R.11	The system also allows users to indicate the categories of items that they intend to buy.
R.12	The system provides periodic notifications of available time slots in a day/time range.
R.13	The system shows the list of shops.
R.14	The system shows the available time slots for each grocery.
R.15	The system shows the customer's position in the line.
R.16	The system requires a sign up/login.
R.17	The system shows active bookings.
R.18	The system shows the history of bookings.
R.19	The system allows customers to delete a booking.
R.20	The system allows customers only one lining up at a time for each shop.

R.21	The system uses information about the customer that exit the store to infer better the waiting time.
R.22	The system allows the store manager to scan the QR codes.
R.23	The system provides to store manager with a QR code printing service.
R.24	The system allows customers only one booking at a time for each shop.

2 OVERALL DESCRIPTION

2.1 Product perspective

C-Lup helps to manage the influx of people both inside and outside the stores avoiding crowding. It represents the digital counterpart of the traditional mechanism of lining up that is not suitable in a lockdown situation.

In the following, a summary of the problem is presented.

- The customers who want to avoid standing outside of stores for hours requires a digital lining up using the C-Lup platform. They select the option for lining up and specify the store and the thematic sectors that they want to visit. Furthermore, they indicate the expected duration of the visit if it is not automatically inferred from the previous visits by the system. Then, the system provides an estimation of the waiting time and shows this and the other active reservations in a specific section of the software. According to the time that the customers need to get to the shop from the place they currently are and with the waiting estimation, the system sends a notification when the customers' number is near to be called. Lastly, the customers can delete a lining up at any time and they can have only one active line up at a time for each store.
- The customers can also book a visit to the supermarket. As seen for the lining up, even for the booking they specify the store and the thematic sectors that they want to visit and the expected duration of the visit if it is not automatically inferred. Moreover, in this case, they need to indicate the time slots when they want to visit the store. The system shows this and the other active reservations in a specific section of the software. Lastly, the customers can delete a booking at any time, and they can have only one active booking at a time for each store.
- If the desired shop is not available in the selected time slot for any reason, the system gives the customers some suggestions about different time slots or different stores. Moreover, the system can alert customers when a new time slot becomes available.
- For each reservation, C-Lup generates a QR code that the customers must scan at the entrance and exit of the shop. The system gives the possibility to print the QR code too.
- People who do not have access to the required technology are also allowed to line up at the store. The store managers help them and give them a printout of the QR code and the estimated waiting time.

- The store managers own a special version of C-Lup that has no limits on the number of reservations. This allows to manage the lining up also for people who do not have access to the required technology. They can also scan a QR code to allow customers to enter and exit from the store.
- C-Lup requires registration to access its functions. This allows to track the duration of the previous visits and use this information to better manage the influx of people and estimates with acceptable accuracy the waiting time.

2.1.1 Class Diagram

The UML class diagram below represents a conceptual, high-level model of the software to be. Givens its nature, it may model objects that will not be represented in the system that will be developed. Moreover, at this level, it should not include any references to methods and other low-level details that will be detailed during the design phase.

2.2.2 State Charts

2.2.2 State Charts

2.2 Product functions

As described above in this document, C-Lup offers several functions that help to manage the influx of people both inside and outside the stores. In the following, a list of the basic and advanced functions is presented.

- **Line up**. The system allows to:
    - specify the store and the thematic sectors that customers want to visit;
    - indicate the expected duration of the visit;
    - delete a lining up at any time;
    - see the list of the active reservations;
    - see the history of the reservations;
    - send a notification according to the time that the customers need to get to the shop from the place they currently are and with the waiting estimation.
- **Booking**. The system allows to:
    - specify the store and the thematic sectors that customers want to visit;
    - indicate the expected duration of the visit;
    - delete a booking at any time;

- see the list of the active reservations;
- see the history of the reservations;
- send a notification according to the time that the customers need to get to the shop from the place they currently are and with the waiting estimation;
- Suggestions about different time slots or different stores if the desired shop is not available in the selected time slot for any reason. The system can also alert customers when a new time slot becomes available;
- indicate the time slots when they want to visit the store.
- **Fallback option**. People who do not have access to the required technology can line up at the store too.

Moreover, for each reservation, the system generates a QR code that can be scanned by the store manager at the entrance and exit of the shop. This code can be also printed.

C-Lup requires a sign up to access its functions. This allows to track the reservations from a specific customer and the duration of the previous visits.

2.3 User characteristics

It is possible to distinguish two different types of actors who use the system:

1. **Customer**: someone who wishes to have access to the supermarket. She/He wants to get smart reservations, manage them, see active ones, and explore shop visit history. He/She cannot have more than one active reservation for the same store at a time.
2. **Store Manager**: someone who helps people who do not have access to the required technologies to get a reservation. She/he might also help in the QR code scanning operation. He/She can have an unrestricted number of active reservations at a time.

2.4 Assumptions, dependencies and constraints

2.4.1 Domain Assumptions

D.1	The customers wait until their number is close to being called to approach the store.
D.2	The time that it takes to visit the supermarket is not uniform.

D.3	The approximated expected duration of the visit indicated by the customer is reliable.
D.4	The supermarket is divided into four different thematic sectors (food, electronic, clothing, and care products).
D.5	Customers can get into the store if and only if they scan a valid QR code.
D.6	All customers that want to access the store use the digital system of lining up.
D.7	Each customer visits only the thematic sector specified during the booking or lining up.
D.8	Customers exit from the store only after they had scanned a valid QR code.
D.9	Store data are provided by the store owner and are already present in the DB.
D.10	The store manager with the digital system helps people who do not have access to the required technology to line up directly when they are at the store.
D.11	The store manager prints the QR code for people who do not have access to the required technology.
D.12	The system is applied to medium and large shops[1].
D.13	One and only one customer can enter with one QR code.

3 SPECIFIC REQUIREMENTS

3.1 External Interface Requirements

3.1.1 User interfaces

The system allows store managers and customers to manage the reservations and create new ones at any time. It also uses customers' location information to alert them when their number is close to being called. Lastly, the history of the reservations and a summary of the active ones are other functions that should be provided by the system.

Given these and the other purposes described above in this document, a smartphone is clearly a suitable device to use all necessary functionalities. In general, it satisfies

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[1] Shops that have a dimension greater than 400 square meters (warehouses, laboratories and offices are not included).

all the hardware requirements that will be described below. Hence, a mobile application might be adequate to allow customers and store managers to access the system.

Let us assume that the User Interface (UI) is divided into several sections dedicated to the different functionalities. The following mock-up shows an idea of two of these sections.

The first one describes the Home Page of the application with the list of the active reservations. On the other hand, the second one shows the Booking Page with an example of possible choices and information that should be provided to the customers and store managers.
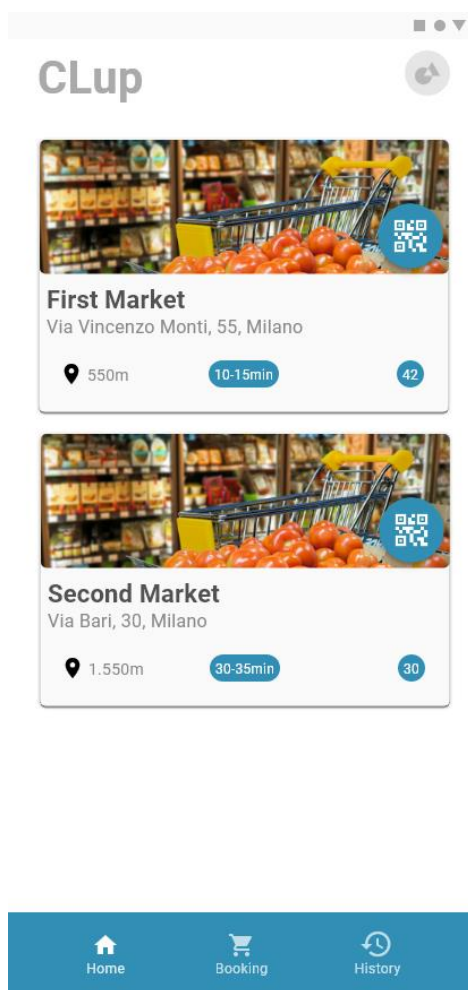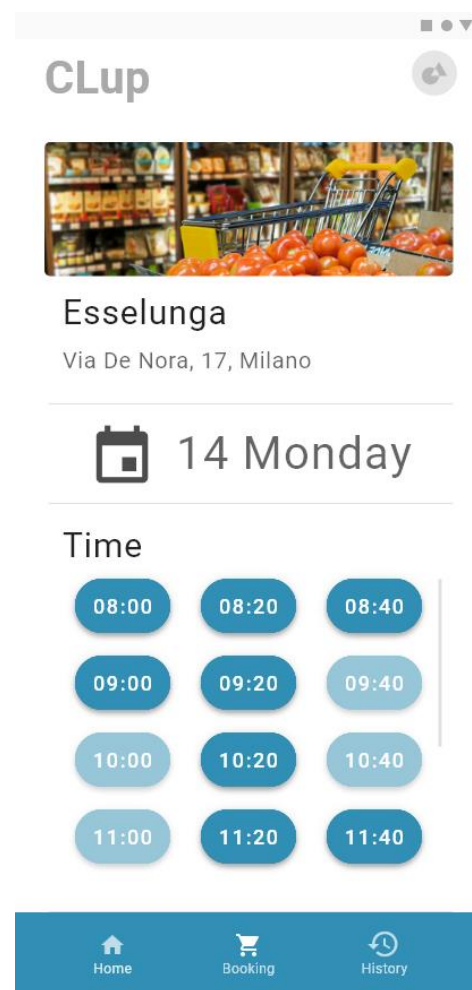

Figure 1 - Home Page mock-up

Figure 2 – Booking Page mock-up

3.1.2 Hardware interfaces

3.1.3 Software interfaces

3.1.4 Communication interfaces

3.2 Functional Requirements

3.2.1 Use cases

1. Sign Up

Name	Sign Up
Actors	Customer
Entry Condition	The actor is not already registered at the system
Event Flow	1. The actor requires the Sign Up Page 2. The system shows the Sign Up Page at the actor 3. The actor fills all the mandatory fields 4. The system checks the information 5. The system saves the information 6. The system shows the Home Page at the actor
Exit Condition	The actor is successfully registered to the system and the home page is shown
Exception	1. Any mandatory fields are not filled 2. Password and Confirm Password fields are different 3. The actor is already present into the system 4. Loss of internet connection 5. The actor cancels the operation before confirming At this level, we assume that the Sign Up process requires some basic information such as name, email, and password. The password must be inserted twice in two different fields to prevent typing mistakes.

2. Login

Name	Login
Actors	Customer, Manager
Entry Condition	The actor is already registered at the system

Event Flow	1. The actor requires the Login Page 2. The system shows the Login Page at the actor 3. The actor inserts the credentials 4. The system checks the information 5. The system shows the Home Page at the actor
Exit Condition	The actor has successfully logged into the system and the home page is displayed
Exception	1. The username is not valid 2. The password is not valid 3. Loss of internet connection 4. The actor cancels the operation before confirming

3. History Reservation

Name	History Reservation
Actors	Customer, Manager
Entry Condition	The actor is already logged into the system
Event Flow	1. The actor requires the History Page 2. The system shows the History Page at the actor 3. The system retrieves the list of reservations 4. The system displays the list of reservations in the History Page
Exit Condition	The Reservation Page and the list of reservations are displayed
Exception	1. Loss of internet connection 2. The actor cancels the operation

4. Booking Page

Name	Booking Page
Actors	Customer, Manager
Entry Condition	The actor is already logged into the system
Event Flow	5. The actor requires the Booking Page 6. The system shows the History Page at the actor 7. The system retrieves the list of reservations 8. The system displays the list of reservations in the History Page
Exit Condition	
Exception	1. Loss of internet connection

2. The actor cancels the operation

3.2.2 Mapping

Goals	Requirements	Domain Assumptions	Use Cases
G.1	R.1 R.2 R.6 R.15 R.17 R.18 R.19 R.22	D.5 D.6 D.9 D.12	
G.2	R.2 R.3 R.4 R.5 R.6 R.9 R.10 R.15 R.16 R.21 R.22	D.1 D.2 D.3 D.6 D.8 D.9 D.12	
G.3	R.11 R.12 R.13 R.20	D.4 D.7 D.9 D.12	
G.4	R.6 R.7 R.8 R.14 R.16 R.22 R.23 R.24	D.5 D.6 D.8 D.10 D.11	
G.5	R.2 R.6 R.7 R.8 R.9 R.10 R.11 R.12 R.13	/	

G.1	Allows to regulate the influx of people that enter the building.
D.5	Customers can get into the store if and only if they scan a valid QR code.
D.6	All customers that want to access the store use the digital system of line up.
D.9	Store data are provided by the store owner and are already present in the DB.
D.12	The system is applied to medium and large shops.
R.1	The system generates a single QR code to enter and exit the store for each booking or lining up.
R.2	The system allows customers to book a visit to the supermarket.
R.6	The system allows people (who do not have access to the required technology) digitally line up directly when they are at the store.
R.15	The system shows the customer's position in the line.
R.17	The system shows active bookings.
R.18	The system shows the history of bookings.

R.19	The system allows customers to delete a booking.
R.22	The system allows the store manager to scan the QR codes.

G.2	Avoids that customers must line up and wait outside of stores for hours.
D.1	The customers wait until their number is close to being called to approach the store.
D.2	The time that it takes to visit the supermarket is not uniform.
D.3	The approximated expected duration of the visit indicated by the customer is reliable.
D.6	All customers that want to access the store use the digital system of lining up.
D.8	Customers exit from the store only after they had scanned a valid QR code.
D.9	Store data are provided by the store owner and are already present in the DB.
D.12	The system is applied to medium and large shops.
R.2	The system allows customers to book a visit to the supermarket.
R.3	The system provides customers a precise estimation of the waiting time.
R.4	The system uses the customers' current position to estimate the waiting time.
R.5	The system alerts the customers before their shift according to the geolocation information.
R.6	The system allows people (who do not have access to the required technology) digitally line up directly when they are at the store.
R.9	The system allows customers to insert the approximate expected duration of the visit.
R.10	The system infers customers' expected duration of the visit based on an analysis of the previous visits.
R.15	The system shows the customer's position in the line.
R.16	The system requires a sign up/login.
R.21	The system uses information about the customer that exit the store to infer better the waiting time.
R.22	The system allows the store manager to scan the QR codes.

G.3	Crowding is avoided in all forms inside the shop.
D.4	The supermarket is divided into four different thematic sectors (food, electronic, clothing, and care products).
D.7	Each customer visits only the thematic sector specified during the booking or lining up.
D.9	Store data are provided by the store owner and are already present in the DB.
D.12	The system is applied to medium and large shops.
R.11	The system also allows users to indicate the categories of items that they intend to buy.
R.12	The system provides periodic notifications of available time slots in a day/time range.
R.13	The system shows the list of shops.
R.20	The system allows customers only one lining up at a time for each shop.

G.4	Everyone must be able to shop, even people who do not have access to the required technology.
D.5	Customers can get into the store if and only if they scan a valid QR code.
D.6	All customers that want to access the store use the digital system of lining up.
D.8	Customers exit from the store only after they had scanned a valid QR code.
D.10	The store manager with the digital system helps people who do not have access to the required technology to line up directly when they are at the store.
D.11	The store manager prints the QR code for people who do not have access to the required technology.
R.6	The system allows people (who do not have access to the required technology) digitally line up directly when they are at the store.
R.7	The system suggests alternative time slots for visiting the store when the desired one is not available.
R.8	The system suggests alternative stores when the desired one is not available.
R.14	The system shows the available time slots for each grocery.
R.16	The system requires a sign up/login.

R.22	The system allows the store manager to scan the QR codes.
R.23	The system provides to store manager with a QR code printing service.
R.24	The system allows customers only one booking at a time for each shop.

G.5	Managing by customers of lining up and booking with a smart digital system.
R.2	The system allows customers to book a visit to the supermarket.
R.6	The system allows people (who do not have access to the required technology) digitally line up directly when they are at the store.
R.7	The system suggests alternative time slots for visiting the store when the desired one is not available.
R.8	The system suggests alternative stores when the desired one is not available.
R.9	The system allows customers to insert the approximate expected duration of the visit.
R.10	The system infers customers' expected duration of the visit based on an analysis of the previous visits.
R.11	The system also allows users to indicate the categories of items that they intend to buy.
R.12	The system provides periodic notifications of available time slots in a day/time range.
R.13	The system shows the list of shops.

3.3 Performance Requirements

3.4 Design Constraints

3.4.1 Standards Compliance

3.4.2 Hardware Limitations

3.4.3 Any Other Constraints

3.5 Software System Attributes

3.5.1 Reliability

3.5.2 Availability

3.5.3 Security

3.5.4 Maintainability

3.5.5 Portability

4 FORMAL ANALYSIS USING ALLOY

5 EFFORT SPENT

This section shows the amount of time that each member has spent to produce the document. Please notice that each section, diagram, and specification is the result of a coordinated work. The column *Member* specifies only the main contributor (or contributors, if more than one) for each topic but should not be interpreted as a lack of participation by other team members.

TOPIC	MEMBER	HOURS
General brainstorming and interpretation of the domain	Digregorio, Massaro, Tamma	3.5h
Creation of the document and identification of the goals	Digregorio, Massaro, Tamma	3h
World and shared phenomena	Digregorio, Massaro, Tamma	2.5h
Requirements	Digregorio, Massaro, Tamma	3h

Mock-up	Digregorio	2,5h
Mapping between goals, requirements, and domain assumptions	Digregorio, Massaro	2h
Improvement on goals, requirements, and domain assumptions	Tamma, Massaro	1,5h

6 FORMAL ANALYSIS USING ALLOY