CLup - Customers Line-up

Requirements Analysis and Specification Document

1 Introduction

1.A Purpose

Customers Line-up is an application that allows users to make reservations for visiting a grocery store.
The idea arises in a context of sanitary emergency, in which people experience a lockdown situation and should be as safe as possible, in order to prevent the evolution of a pandemic and all its consequences on society. Of course, grocery shopping is an essential need, but all the activities connected to it must be highly regulated, so that crowds are avoided and safety is guaranteed.
A typical rule for supermarkets, in an epidemic situation, is to restrict access, in order for people to keep enough distance while doing the shopping. However, the immediate consequence of this measure is physical lining up, which is in turn a problem: crowds form and social distancing can become far from reality.
Customers Line-up is thought for avoiding this kind of situation, enabling a way to queue up virtually and prevent any sanitary risk: the influx of people inside the store is regulated, customers have interests in reserving a ticket (to enter) from their cars or homes, and rules to contrast the pandemic are respected on all sides.
To resume, the goals of the software system are those of granting social distance outside supermarkets, managing entrances and avoiding crows inside them. A list of the application's goals is presented here.

GOALS	
G1	Grant social distance outside the grocery store **G1.1**: Avoid physical lining up outside the grocery store*
G2	Manage entrances in the grocery store
G3	Avoid crowds (too many people) inside the grocery store (at the same time)

** G1's subgoal; from now on, references to this subgoal will be made using **G1.1** abbreviation*

1.B Scope

According to Michael Anthony Zackson and Pamela Zave's standard model for requirements engineering, this section proposes an overview of World and Shared phenomena connected to the environment where *Customers Line-up* is thought to work.

WORLD PHENOMENA	
WP1	A customer wants/needs to go to the grocery shop
WP2	A customer gets to (or approaches) the grocery shop by car/by bike/on foot/any other means of transportation
WP3	A customer inside the grocery shop decides to buy an item
WP4	A customer does the grocery shopping in a particular order
WP5	A customer pays at the check-out
WP6	

SHARED PHENOMENA - WORLD CONTROLLED	
SPW1	A customer gets a ticket
SPW2	A customer deletes his booked ticket
SPW3	A customer books a visit
SPW4	A customer deletes his booked visit
SWP5	A customer exits from the grocery shop
SWP6	A time slot is available for a reservation
SPW7	A customer gets a ticket/books a visit, but does not go to the grocery shop
SPW8	A customer gets a ticket/books a visit, but arrives at the grocery shop too late (after his turn and the associated time limit to enter)

SHARED PHENOMENA - MACHINE CONTROLLED	
SPM1	A customer enters in the grocery shop
SPM2	A customer is notified for entrance

SPM3	A customer is notified to leave from home
SPM4	A customer receives a notification suggesting to book a visit in his habitual grocery shop, day of the week and hour
SPM5	After a failure in the attempt to reserve a visit (due to time slots unavailability), a customer receives a suggestion to book in a different grocery shop
SPM6	After a failure in the attempt to reserve a visit (due to time slots unavailability), a customer receives a suggestion to book in a different date/time and same grocery shop

1.C Definitions, Acronyms, Abbreviations

1.C.1 Definitions

- **Customer:** a person who does/is going to do the grocery shopping
- **Ticket machine:** a machine equipped with a touchscreen display, a printer system, a QR code reader and an *ad-hoc* version of *Customers Line-up* application
- **User:** a person who has downloaded *Customers Line-up* mobile application on his smartphone/tablet and has successfully logged in **OR** a person who uses *Customers Line-up* services through a ticket machine **OR** a person who uses *Customers Line-up* services by calling the call center

1.C.2 Acronyms

- **QR:** *Quick Response*
- **GPS:** *Global Positioning System*
- **RASD:** *Requirements Analysis and Specification Document*
- **CLup:** *Customers Line-up*
- **IVR:** *Interactive Voice Response*
- **SMS:** *Short Message Service*
- **DB:** *Database*
- **SIM:** *Subscriber Identity Module*
- **UML:** *Unified Modeling Language*

1.C.3 Abbreviations

Gn	Goal number n	*Defined in section 1.A*

WPn	World phenomena number n	*Defined in section 1.B*
SPWn	Shared phenomena (World controlled) number n	*Defined in section 1.B*
SPMn	Shared phenomena (Machine controlled) number n	*Defined in section 1.B*
DAn	Domain assumption number n	*Defined in section 2.D.1*

1.D Revision history

Version	Date	Authors	Summary
1.0		Cosimo Sguanci, Roberto Spatafora, Andrea Mario Vergani	First release

1.E Reference Documents

- Software Engineering 2 slides (available on the Beep page of the course)
- Project assignment document (“R&DD Assignment A.Y. 2020-2021.pdf” available on the Beep page of the course)
- RASDs developed by colleagues of past years (available on the Beep page of the course or on GitHub)

1.F Document structure

- ➢ **Section 1** provides an overview of *Customers Line-up*'s goals and the context in which it is thought to work. In addition, all released versions of this document are summarized in an appropriate paragraph.
- ➢ **Section 2** …
- ➢ **Section 3** …
- ➢ **Section 4** …
- ➢ **Section 5** summarizes the total effort spent for realizing the *Requirements Analysis and Specification Document* by each group member.
- ➢ **Section 6** lists all references that helped the team during analysis and document writing.

2 Overall description

2.A Product perspective

2.A.1 Further details on the Shared Phenomena

Shared phenomena controlled by the World and observed by the Machine

- **SPW1:** A customer gets a ticket
  A customer can acquire a ticket reservation by using one of *CLup*'s application interfaces; a ticket corresponds to virtual lining up and is associated with a code for entering the selected grocery shop. After getting a ticket, the user waits until his turn comes.
- **SPW2:** A customer deletes his booked ticket
  A customer can delete a ticket reservation by using one of *CLup*'s application interfaces. When a ticket is deleted, the user implicitly leaves the waiting "queue" which regulates entrances in the grocery shop.
- **SPW3:** A customer books a visit
  A customer can book a visit reservation by using one of *CLup*'s application interfaces; a visit is associated with a grocery shop, date, hour and a code for entrance. A visit can be reserved either for the current day or in advance.
- **SPW4:** A customer deletes his booked visit
  A customer can delete a visit reservation by using one of *CLup*'s application interfaces. When a visit is deleted, the user frees the time slot associated with it.
- **SPW5:** A customer exits from the grocery shop
  When a customer exits from a grocery shop, he has to show the code associated with his reservation to an appropriate system: in this way, *Customer Line-up* can know the actual number of people inside the supermarket (and other information) and has the possibility to manage the influx of new people.
- **SPW6:** A time slot is available for a reservation
  When a time slot is available, every customer using *CLup* services can book it for having access to the corresponding grocery shop. Of course, time slots availability is associated with already registered reservations.
- **SPW7:** A customer gets a ticket/books a visit, but does not go to the grocery shop
  A customer might, for many reasons, not respect a reservation: this is the case of a person who completely forgets about his booked visit, or does not delete it (after deciding not to go to do the shopping). *Customers Line-up* in a sense tries to prevent these situations, and on the other hand reacts in an appropriate way when it faces them.

- **SPW8:** A customer gets a ticket/books a visit, but arrives at the grocery shop too late (after his turn and the associated time limit to enter)
  A customer might be late for many reasons: wrong time estimation to get to the grocery shop, other commitments, ...
  Customers Line-up in a sense tries to prevent these situations (making it easy to arrive on time), and on the other hand reacts in an appropriate way when it faces them.

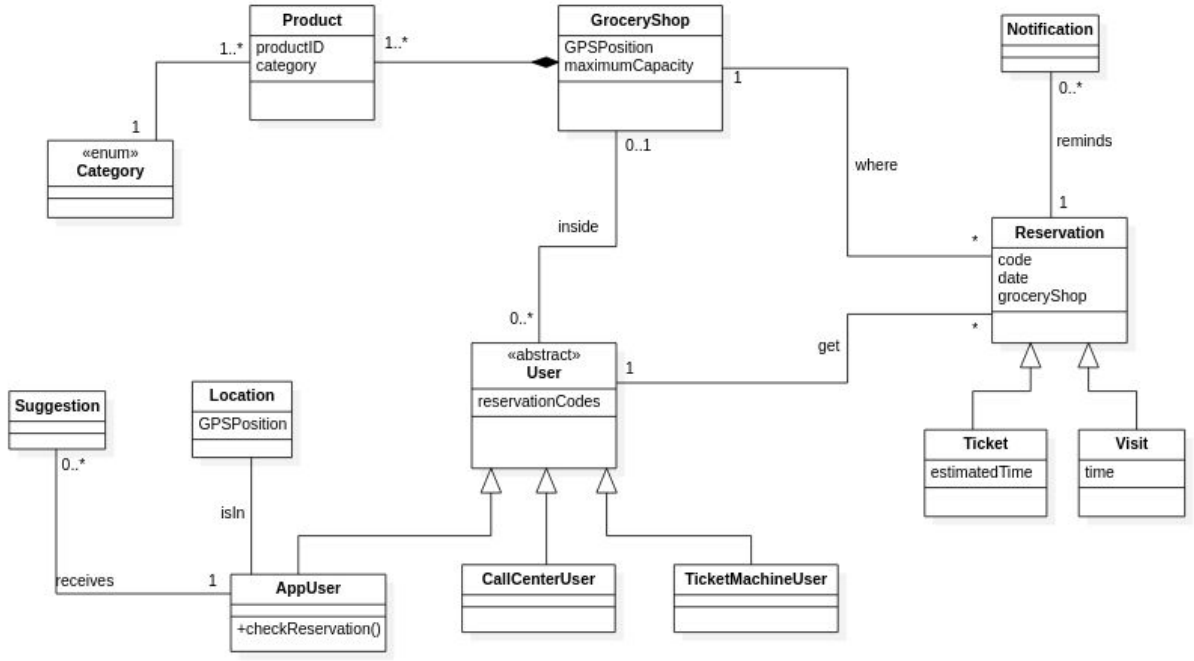
Shared phenomena controlled by the Machine and observed by the World

- **SPM1:** A customer enters in the grocery shop
  A customer can access the grocery shop only if he has a reservation. In practice, the user waits in the supermarket's proximity until his turn comes; then, he can enter only by showing (or typing) the code associated with his visit/ticket at the shop's entrance. Once in, the person can do the shopping.
- **SPM2:** A customer is notified for entrance
  CLup mobile application users, waiting for their turn outside the supermarket, receive a notification (on the app and via SMS) when they are allowed to enter. This system is very useful in order to guarantee social distance, permitting people to wait where they prefer: in fact, every communication message can arrive through *Customers Line-up* mobile application.
- **SPM3:** A customer is notified to leave from home
  CLup mobile application users, who have already booked a reservation for the current day, receive a notification (on the app) when it is time to leave from the place they are in order to reach the supermarket (on time). In this case, information about the customer's position is known thanks to GPS.
- **SPM4:** A customer receives a notification suggesting to book a visit in his habitual grocery shop, day of the week and hour
  CLup mobile application users might receive notifications (on the app) when an appealing time slot is available. In practice, the system tries to infer customer's habits and proposes ideal options to do the grocery shopping; most likely days, hours and supermarkets for every user are derived from customized statistics.
- **SPM5:** After a failure in the attempt to reserve a visit (due to time slots unavailability), a customer receives a suggestion to book in a different grocery shop
  Due to general restrictions and imposed maximum number of people inside every grocery shop, it might be the case that many time slots for reservation are unavailable (already booked). Of course, this might be stressing for a customer, because finding an option for grocery shopping can be harder than expected. *Customers Line-up* tries to help mobile app users, by proposing alternatives when their first choice for a visit is not available: a

proposal consists in a different shop (close to the selected one), in the same day and (approximately) hour chosen by the customer.

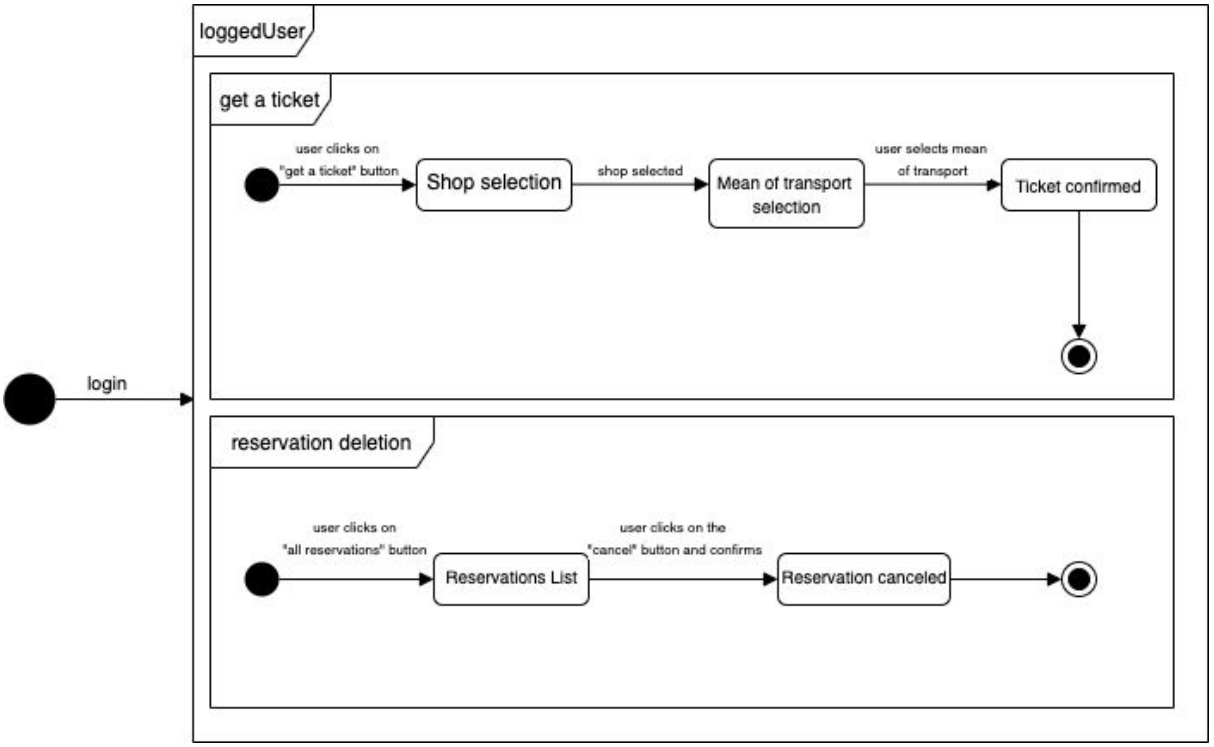
- **SPM6:** After a failure in the attempt to reserve a visit (due to time slots unavailability), a customer receives a suggestion to book in a different date/time and same grocery shop
  As described before, *Customers Line-up* helps mobile app users in finding the perfect visit for them, in case their first choice is not available. A proposal can be a different date/hour (with similarities to the selected ones) and same shop. The customer can accept the suggestion or decide to manually look for other options.

2.A.2 UML Class Diagram

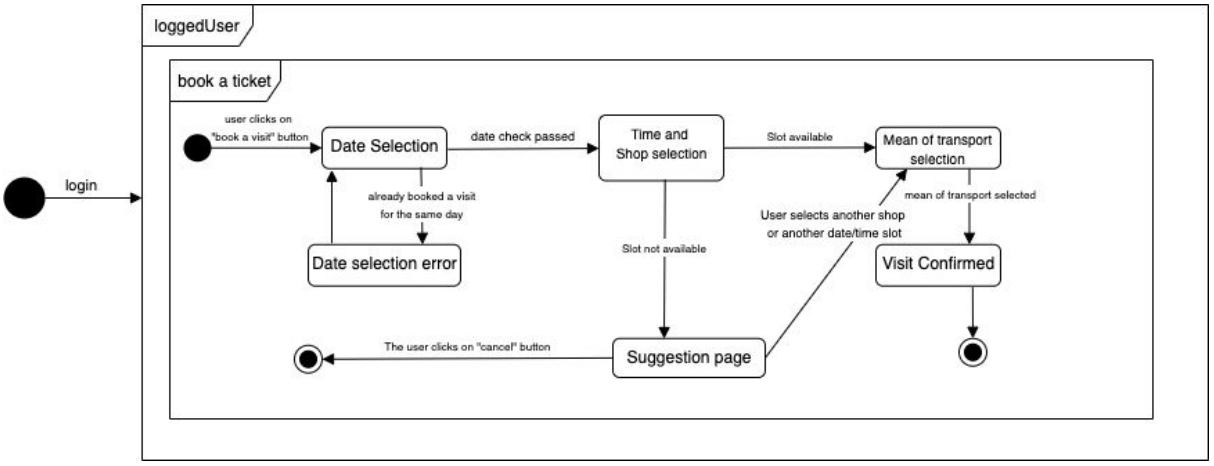


2.A.3 UML Statechart Diagrams

1) State diagrams that show the flow followed by a user when it wants to get a ticket for a shop, and when it needs to delete an already booked visit or ticket.



2) State diagram that highlights the flow followed by a user when it wants to book a visit for a specific supermarket, showing possible errors and suggestions given to the customer.



2.A.4 Scenarios

- **Get a ticket from CLup app**
  Alice, on Thursday afternoon, on the way back home from her office, decides to go to the supermarket to buy the necessary for dinner. For this reason, she uses the CLup app to check if there is any ticket available with less than 15 minutes of estimated waiting time at her favorite shop (ABC shop). The app shows her that the estimated waiting time for the next ticket in the ABC shop is 10 minutes. So she gets the ticket and continues her way to the shop.

- **Book a visit from CLup app**
  Stefania really likes planning all her activities for the coming week on Monday morning. She works in the city hospital and according to her timetable, she has only time to go to the supermarket on Wednesday. Therefore, in order to have the access to the BCD shop granted, on Monday she decides to use the CLup app to book a visit for Wednesday at 10am. The requested time slot for the visit is available so, after the insertion of the expected duration of the visit and the list of items she plans to buy, the reservation is confirmed and she can go on the day desired.

- **Suggest an alternative, the requested visit is not available**
  Andrea would like to go to his usual grocery, Esselunga (very close to his house), tomorrow at 5pm. It is very important to go tomorrow, because he has almost nothing in the fridge and his wife is complaining a lot about this fact.
  Andrea uses the CLup app on his smartphone to book a visit for tomorrow: he selects his usual supermarket, date and time for the visit. Unfortunately, a message tells him that there is no availability for his request; anyway, the system suggests him another date for his favourite Esselunga (in two days' time, always at 5pm) or another Esselunga shop (a little bit further from his house, but not very distant), available tomorrow at 5pm. Since it is very important for him to do the grocery shopping tomorrow, he accepts this latter advice: he books a visit for tomorrow at 5pm at the suggested Esselunga shop.

- **Available slot suggestion**
  Marco is used to going to the grocery shop close to his house on Saturday afternoon; he always books a visit using *CLup* application on his smartphone, in order to avoid crowds and respect social distance. Due to his high number of reservations in the last months, the system knows Marco's habits about grocery shopping: in fact, the man receives a notification on Monday about an available slot for next Saturday at 4pm. As soon as Marco sees the notification on his smartphone, he fills all requested data for the reservation and books the suggested visit for Saturday: in this way, his habits will continue to be respected also for this week.

- **Notification based on GPS position**
  Antonella has a very busy life, with two little children and a full-time job. Three days ago, she used *CLup* application for booking a visit to her usual supermarket: her turn is today at 4pm. However, her busy life has made her forget about the reservation, and at 3.30pm she is still totally unaware of it. But her smartphone has GPS services running, so at 3.32pm she receives a notification about the approaching turn: so, she immediately gets dressed and goes to the supermarket (approximate time from home to the shop is 10 minutes by car: this information is known by the system thanks to GPS position). She is able to get there at 3.55pm, totally in time for her turn.

- **Delete a ticket reservation**
  Alessandro, because of a sanitary emergency in his country, would like to avoid waiting for his turn in the supermarket's proximity. He has a smartphone and, through CLup app, decides to get a ticket: the expected time before being called is 2 hours. But in the meanwhile, he receives an important job call: he will be busy for the next four hours, so he deletes his ticket reservation through the application; the system notifies him that this operation went fine.

- **Delete a visit reservation**
  Marta works from Monday to Friday as a teacher, so she usually goes to do the grocery shopping on Saturday afternoon. For this reason, she decides, using *CLup* mobile application, to book a visit to the supermarket for next Saturday, at 2pm. But as soon as she remembers that next Saturday she must pick her nephew up from school, she decides to delete her visit reservation (always with the app): the system notifies that this operation went fine, and the 2pm time slot for Saturday is now free for some other customer(s).

- **Entrance in the grocery**
  Matteo is waiting in his car just outside his favourite grocery. Using *CLup* app on his smartphone, he has already got a ticket and his turn is approaching: he knows it thanks to the notification, received a few minutes ago. When it is time to enter, a new notification arrives and Matteo opens the app: he sees the QR code for entrance and a message telling him that it is his turn; QR code will expire in 10 minutes, as shown by another message (in the upper part of the smartphone's screen).
  Matteo gets out of the car and enters the supermarket by showing his QR code to the scanner at the entrance: doors open and he can get into the grocery.

- **Get a ticket from call center**
  Gabriele, a single forty eight-year old man, wants to go to the grocery shop, on the way home from work by car, to buy the necessary food for the next few days. When he tries to log in the CLup app, he notices that he has no mobile connection available at that moment. So, he decides to call at the call center in order to get a ticket and be able to buy something for the current day. The call center operator tells him that the next ticket available in the requested supermarket has an expected waiting time of 20 minutes. After

Gabriele's confirmation, the operator tells him a numeric code that he will use for the entrance. Moreover the call center operator reminds Gabriele that he will be notified, with a SMS, at the moment he can access the shop. Therefore, Gabriele decides to approach the supermarket and waits for his turn on the car. At the moment he receives the SMS notification he approaches the entrance, shows its numeric code and enters the supermarket.

- **Book a visit from call center**
  Lucia is a seventy-year-old woman without a smartphone. On Wednesday, she decides to go to the grocery shop to buy food for the next few days and, given the current rules about safety distance, she knows that she must get a ticket (for entrance) at one of the ticket machines. She approaches the ticket machine, but she reads on its screen a message saying "Expected waiting time for tickets is: 4 hours". Of course, 4 hours are much more than what Lucia was expecting, so she decides to come back home and call the call center to book a visit for another day. On the phone, she establishes a reservation next Friday at 3p.m., with the call center operator which confirms her reservation telling her a numeric code that she will use to enter the market on Friday. Lucia will come to the supermarket on Friday.

- **Get a ticket from ticket machine**
  Antonio, an eighty-year-old man without a smartphone, approaches a grocery shop on foot, with the intention to buy all necessary for next week. Given the current rules about safety distance, he knows that he must get a ticket (for entrance) at one of the ticket machines outside the supermarket: he selects "Ticket" option on the touchscreen (wearing disposable gloves available near the ticket machine itself) and a ticket with a QR code is printed, together with a 6-digits number identifying his turn; in addition, the screen shows a message telling him that the expected waiting time before his turn is 15 minutes. Antonio decides to walk around and comes back after 10 minutes; two (more) minutes later, his turn comes and the identification number appears on the waiting-screen at the top level of the queue. The man approaches the shop's entrance and shows his QR code (on paper) to the scanner positioned there: doors open and he can get into the supermarket.

- **Ticket machine suggests to reserve the next available slot: no more ticket for the current day are available**
  Giuseppe, an eighty-year old man without a smartphone, approaches a shop on foot, with the intention to buy all necessary for next week. Given the current rules about safety distance, he knows that he must get a ticket (for entrance) at one of the ticket machines outside the supermarket: he selects the "Ticket" option on the touchscreen (wearing disposable gloves available near the ticket machine itself). Unfortunately there are no tickets available for the current day anymore. Thus, the screen shows a message which invites him to reserve the first available slot in the shop in the next few days. The proposal refers to a reservation for the next day at 3pm. Giuseppe accepts the suggestion and reserves a slot for the next day.

2.B Product functions

Customers Line-up is an application born with the intention of avoiding (physical) crowds outside grocery stores, during a critical epidemic situation. Of course, together with basic functions associated with the need of respecting social distance, the software provides a series of additional features, further detailed in this section.
A list of *CLup* main functionalities follows.

- **Get a ticket**
  Customers who would like to reserve a ticket for accessing the supermarket, without physically lining up, can get one using *Customers Line-up* service. The feature of getting a ticket can be achieved in three ways: the first one is using a smartphone/tablet, the second one calling *CLup*'s call center, the last one with a ticket machine (outside the grocery shop).
  Tickets correspond to "virtual" lining up: when someone gets a ticket, he becomes the last one to wait in the "queue"; if current day's time slots are all reserved (according to the supermarket's opening hours), no more tickets are assigned. A relevant aspect is that visits fill the same "queue" as tickets, but they can be reserved in advance (so, also some days/weeks before the date of the visit itself); in addition, in case of delay or incorrect waiting time estimation because of external factors, visits have priority in being called: visit time is more likely to be respected rather than ticket expected time (a person with the ticket can wait more because entrance hour is not guaranteed, while visit one tends to be, according to real world situations).
  Every customer can download *CLup* application on a mobile device; in order to get a ticket with the app, the guest needs to be registered and specify which grocery shop he wants to visit.
  People not owning a smartphone/tablet can get a ticket reservation by making a phone call to *Customers Line-up* freephone number: in this case, the user can complete the procedure interacting with an IVR system featured with voice recognition, or talking to a human operator; the selected grocery shop and a mobile phone number for SMS notifications (when his turn comes) must be specified.
  In alternative, a person can go directly to the supermarket and get his ticket (if available for that day) using a ticket machine: in this case, there is no need to specify the grocery shop (implicit: it is the closest one), nor to be registered; tickets are printed on paper in the form of QR code, with the addition of a 6-digits number identifying the turn in the waiting "queue".

- **Book a visit**
  People, through *CLup* service, can book a visit for accessing the supermarket, avoiding physical lining up. The functionality of booking a visit, with strong analogy to a ticket reservation, can be achieved in three ways:

using a mobile device, calling the call center or with a ticket machine (outside the grocery shop).
Every customer can download *CLup* mobile application; in order to book a visit with the app, he needs to be registered and specify which grocery shop he wants to visit, in which day and time. A user might also specify the approximate duration of his visit and the categories of items (if not exact items) he is going to buy, in order to help the system to coordinate other customers' visits/entrances with tickets.
The second option to book a visit is through *Customers Line-up* call center: the procedure is very similar to the one of getting a ticket; the only difference consists in specifying, in addition to the selected grocery shop and a mobile phone number, the day and time for the reservation.
Alternatively, if there aren't available tickets for the rest of the day, a visit for the first available slot can be booked directly from outside the supermarket, using a ticket machine. Visit reservations are printed on paper in the form of QR code (with the addition of a reservation receipt containing all relevant information: supermarket, date, time, 6-digits number for turn identification in the "queue").

- **Delete a reservation**
  Users can delete reservations connected to a ticket or to a booked visit. In order to do so with the mobile application, the user should open the page regarding information about his tickets/visits and select the one he wants to delete.
  The equivalent operation can be performed for tickets or visits connected to a call center reservation: the user should call *Customers Line-up* freephone number and follow the steps until deletion has been confirmed.
  Finally, for deleting reservations booked using a ticket machine, the customer should simply scan the printed QR code with the machine's scanner.

- ***CLup* suggestion mechanism**
  The system, for registered customers using the mobile application, is able to suggest time slots (for visits) based on specific users' habits. In particular, *CLup* stores all data about customers, days and time for visits, as well as most visited supermarkets; analyzing this data, the application can send customized notifications when an attractive visit can be booked, for example when the habitual shop has available visits for the day the customer usually makes use of it.
  Other features for suggestions include giving alternatives after failures in getting a ticket or booking a visit (because no slots are available): for tickets, the system proposes to get one in the closest supermarket (with respect to the selected one) still available for current day; for visits, suggestion coincides with the proposal of a slot for a different hour/a different day/a close supermarket.
  An important remark consists in saying that these features are available only for customers using the mobile application.

- ***CLup* avoids people crowding inside the supermarket**
  The system can manage slots according to known (or inferred) duration of customers' visits and categories of items to buy. The general idea is that, knowing more information, *CLup* can more precisely stagger reservations in order to avoid crowds inside the supermarket. Data is collected by the system; the user can specify it (approximate visit duration and categories/list of items) when booking a visit. In any case, additional relevant information is also retrieved on the spot: time duration spent inside the supermarket and bought items. The information about the average time spent inside the shop by a single user is used to adjust the timetable for other users that may want to book an entrance for the same day: if a user with an average time of visit of one hour and a half booked a place for 6 pm, other users will see his available place starting from 7:30 pm.
  At the same time, data about which items are usually bought by a single customer is used to show different available slots to different users: there is a risk of crowding inside the shop if too many customers that buy similar or near products book a slot for the same date and time.
  The described feature is customized for mobile application users; for customers without the app, estimations are performed (according to average data collected for all the users).

- ***CLup* sends notifications based on GPS position**
  The system, for registered customers using the mobile application and having an active GPS connection on their smartphones, is able to notify them when their reservation (ticket or visit) is approaching. In particular, every time a visit is being booked, the user is asked which kind of means of transport he/she is going to use. This information, combined with the real-time GPS position, allows *CLup* to compute the time needed to get to the supermarket and send the customer a push notification so that he can get on time to the grocery shop, without forming unnecessary crowds outside the shop.
  If GPS connection is not active, the user still receives notifications about an approaching reservation, but only in predefined times. However, both mobile app and call center users receive a notification/SMS when their turn has come.

2.C User characteristics

Considering that supermarkets usually sell primary goods, the range of possible users of *CLup* is very wide: basically, every person is a potential user of the system.
If we consider the various types of customers, we can identify the following three categories:

- **Mobile App User**: a person who can take advantage of all the functionalities of *CLup* through the use of the mobile application. Once the user is registered and logged in, he is able to get a ticket or book a visit at any shop, and handle all the reservations he has made. By taking advantage of the real time GPS position and mobile app push notifications, the customer can be notified in order to know when it is time to leave from the current position and when it is his turn to enter the shop.

- **Ticket Machine User**: a person who does not have the mobile app, therefore is not registered and wants to get a ticket as he arrives at the supermarket. This kind of user is only able to get tickets or, if there are no tickets available for the current day, he can book a visit for the first available slot.

- **Call Center User**: a person who does not have the mobile app, therefore is not registered but still wants to get a ticket or book a visit before getting to the supermarket. Giving his mobile number to the call center operator or IVR system, the user can be notified by SMS when his turn comes, avoiding the need to line up physically outside the shop.

2.D Assumptions, dependencies and constraints

2.D.1 Domain assumptions

DA1	The grocery shop has a maximum capacity for people inside
DA2	Only one person enters the grocery shop for every ticket
DA3	Only one person enters the grocery shop for every visit
DA4	People inside the grocery shop respect social distance as imposed by safety rules of the country/region
DA5	People at the grocery shop's entrance respect social distance as imposed by safety rules of the country/region (in case a user's turn has come, but he sees another customer at the code reader at the entrance)
DA6	Only a very little part of customers uses ticket machines for reservations, because mobile application and call center guarantee a more comfortable service accessible to almost everyone (people with a smartphone/tablet use the application, people without it can call and book)
DA7	GPS provides the exact location with an error of 10 metres at most
DA8	

2.D.2 Dependencies

- The CLup system will use the internet connectivity of app users' devices.
- The CLup system will use the GPS position of mobile app users' devices.
- The CLup system will interact with an external push notification service to send notifications to mobile app users.
- The CLup system will use a third party API to show maps and compute the time needed to get to the selected shop.
- The CLup backend services will use a DBMS service to store and retrieve data about users and their reservations.

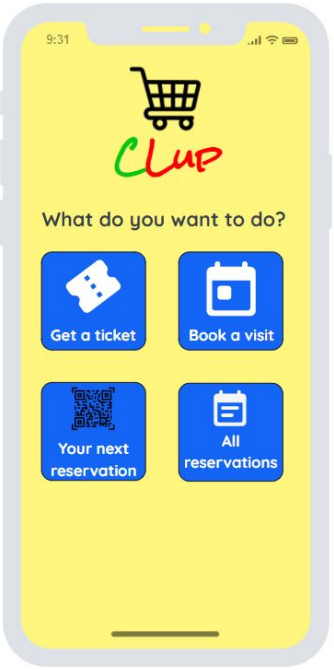
3 Specific Requirements

3.A External Interface Requirements

3.A.1 User Interfaces

3.A.1.1

CLup mobile application interface



- **Home page**

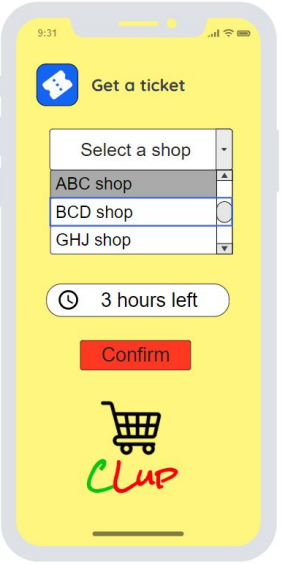
The home page of *CLup* mobile application for logged users shows the following features:

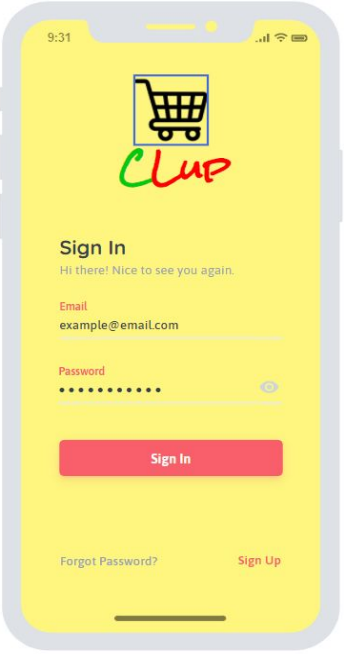
- Get a ticket
- Book a visit
- See the list of reservations
- Manager user (login/logout)

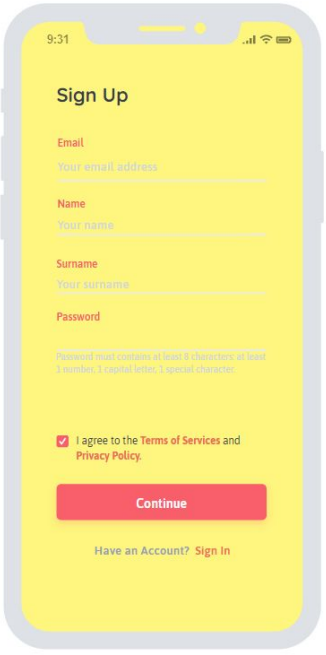
If a user is not logged in, *CLup* only shows a button to sign in/sign up.

- **Get a ticket**

This page allows users to select an available supermarket from a list (shops can also be searched using associated keywords). Once the grocery store has been chosen, users should only confirm to get the ticket reservation.
When users select the shop, a message shows expected time before being called for entrance.





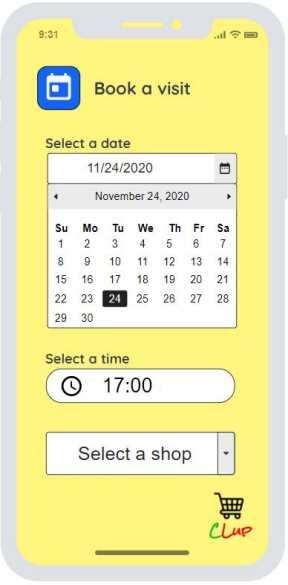


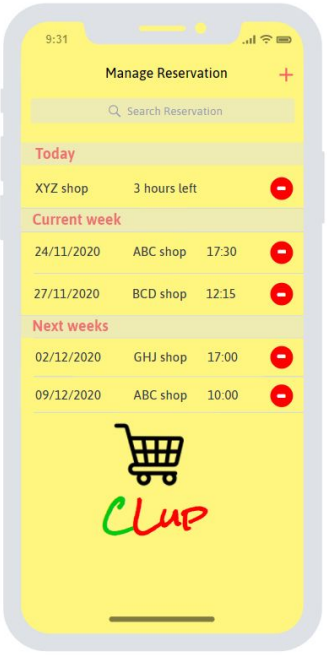
- **Sign up/sign in**

This page allows users to register to the system or log in (if already registered). The user interface allows to insert the email and password; in case of sign up, also name and surname must be added.

- **Book a visit**

This page allows users to select the supermarket from a list (where customers can also search), in addition to the day and the time for the visit from a calendar. Moreover, there are two optional fields for the duration of the visit and the categories of items to buy (or exact items): both duration and categories should be selected from a predefinite list.





- **List of reservations**

The page allows users to get information about estimated remaining time before the turn (in case of ticket) or day and time of the visit. In addition, there is an option for deleting any reservation. Clicking on a single reservation allows the user to update the estimated duration of his visit and the categories of products he is going to buy.

CLup ticket machine interface

- **Home page**

The home page of CLup ticket machine system shows the following options:

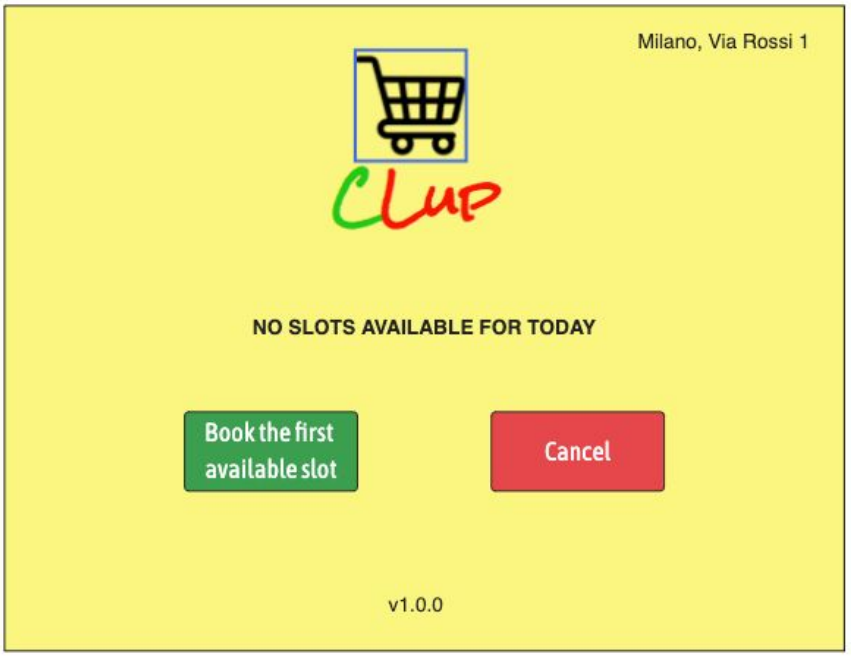
  - Get a ticket
  - Delete a reservation

Customers do not need to register or log in (in fact, there is no option for it).

- **Get a ticket**

This page shows the expected waiting time if any slot is available for the current day.

If no slots are available, an option to book the first available slot is given to the user.



- **Book a visit**

This page shows the expected scheduled date and time for the visit the user is booking.

- **Delete a reservation**

After the reservation's QR Code has been shown to the ticket machine barcode reader, this page displays the details regarding the reservation the user is deleting, and asks for confirmation.

3.A.2 Hardware Interfaces

Users must have a mobile device (smartphone/tablet) equipped with a GPS system and mobile data (Internet connection).
Ticket machines are equipped with a touchscreen display, a QR code scanner and Internet access.
A QR code scanner is present at the grocery store's entrance: it is a scanner which can be activated through a movement sensor on the upper part of it. The scanner is connected with the supermarket's doors, which open when an active QR code has been scanned.
There are screens outside the grocery store which are used for displaying turns, and they must be big enough so that reading from 15 metres away is possible.

3.A.3 Software Interfaces

Regarding the frontend for the mobile application, the app should be compatible with the following operating system:

- Android (from version 5.0 Lollipop in order to be compatible with the 94.1% of the devices [data regarding December 2020, source: android.com])
- iOS (from version 12.0 in order to be compatible with the 94% of the devices [source: apple.com])

The mobile app must interact with the following external software component:

- Geolocalization service (e.g Google Maps SDK)
- Push Notification Service (e.g Google Firebase Cloud Messaging)

Moreover, the CLup's mobile application interacts with CLup's backend services. In particular:

- User authentication services
- Reservation handling services (also used by the operators in call center and the ticket machine)

The backend components make use of a database (relational database or NoSQL) to store data about Users and Reservations. Using a database implies the integration of a software library to interact with the chosen DBMS.

3.A.4 Communication Interfaces

HTTPS protocol is used to grant secure data transmission over the Internet.

3.C Performance Requirements

The system should be able to answer a ticket/visit reservation request in less than 10 seconds. In case there is no availability for the requested reservation, it should provide appropriate suggestions in a reasonable time (together with the requested answer or at most 3 seconds later). Moreover, the system should delete a reservation (when requested) in less than 5 seconds.
CLup, after monitoring client's visit time and duration habits, should be able to extract information from data every 3 days, in order to use it to build statistics and provide suggestions.
The system should monitor real time GPS positions of users who have a reservation in the next hours, in order to be able to send notifications according to requirements.

3.D Design Constraints

3.D.1 Standards compliance

There is no particular necessity to deviate from usual web-standards suggested by the World Wide Web Consortium (W3C); for this reason, the development of the system should follow W3C recommendations.
Any further compliance, if needed, will be specified during the design analysis.

3.D.2 Hardware limitations

The mobile application can be installed only on a smartphone/tablet equipped with a GPS system and the possibility to activate mobile data.

3.E Software System Attributes

3.E.1 Reliability

Customers Line-up should be available 24/7 in order to book visits and manage reservations whenever users want. However, the crucial time in which the system should work coincides with supermarkets' opening hours: for this reason, 4-6 hours of maintenance do not represent a problem, if programmed outside opening hours.

3.E.2 Availability

CLup does not have a very critical nature (it is not connected with emergency situations); however, in case the system is down during opening hours, supermarket's business becomes much more complicated: entrances have to be managed directly from its employees and ticket reservations become impossible; the only thing employees could do is to guarantee the entrance to an appropriate number of people that are waiting outside, without realizing any other feature that the software system guarantees.
For these reasons, 95% availability of the system should be guaranteed.

3.E.3 Security

The system uses HTTPS for a secure communication between users and the server. Since a customer can have more than a visit booked at the same time (for different days), there should be a limit to the number of bookings a user can have simultaneously, in order to guarantee the correct functioning of the system. Moreover, all passwords are encrypted and, in case of recovery, they are not sent in clear.
Possible additional choices will be discussed in the *Design Document*.

3.E.4 Maintainability

Code should follow good software engineering practices and be properly commented. In addition, the use of proper design patterns, as suggested in the *Design Document*, is mandatory.

3.E.5 Portability

Customers Line-up's frontend is composed mainly by a mobile application: to ensure an high grade of portability between Android and iOS an hybrid framework should be used to build the frontend, so to be able to share the most of the code between the two platforms.