CLup

Covid Line up

1. INTRODUCTION
2. Purpose

This document has the purpose to clearly define the functionalities that the system-to-be will provide, the goals it strives to achieve, indicate general use cases and describe its limitations as to guide the engineers’ job and the stakeholders’ decision making.

The system tries to put an end to overcrowding inside common spaces and physical queues as much as possible, as to reduce the possibility of getting infected by Covid-19 while doing a daily activity such as grocery shopping. It will incentivize its users to line up virtually to go to said shops and permit to the shop managers to check how many people are inside at any time.

These goals are formally defined as the following:

* + - Store Manager related:

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| G1 | The store manager should track how many people are inside the store at any point in time. |
| G2 | The store manager should regulate the influx of people that can enter inside the store. |

* + - Store stakeholders and users

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| G3 | Everybody should be able to maintain social distancing inside the stores. |
| G4 | Everybody should be able to maintain social distancing in front of the stores. |

* + - Users and customers

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| G5 | Anyone who wants to book a visit to the stores should decide their desired time to go. |
| G6 | Anyone who wants to go in any store should not need to stand in queue in front of it and wait. |

As subgoals of these last two goals we would have:

Sub-G7: “The ability to know which stores are available to go to, at any moment.”

Sub-G8: “People who cannot go to their desired stores should be notified of other available stores of interest”

1. Scope

In the following tables are listed the most relevant world and shared phenomena. In this application, it is critical to consider, among world phenomena, the behaviour of the user, since there are some factors (e.g. W1,W2,W6,W7) that if not considered and handled, can create problems that may lead to unwanted situation, as the creation of a line in front of the store.

1. World Phenomena

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1. Shared Phenomena

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1. Definitions, Acronyms, Abbreviations

Physical user: the person who goes directly to the market without using the application.

Virtual user: any person who uses the app to line up virtually and asks for a ticket.

User: Either a physical user or a virtual user.

Ticket: QR code that permits you to enter inside the market at a certain time written on the ticket.

Store, Market, Supermarket, Shop: Any building that provides goods and services in return for money and are connected to the CLup application.

Social distancing: the personal space to any single person as an area of radius 1m.

Front of stores: the area that is property of the store and in which people queue up to wait for their turn.

Authorized Account: Account associated to a Shop Manager, formally authorized through adequate procedures.

Inactive User: a virtual user that does not click on any button in the “Get a ticket” or “Book a visit” page.

1. Revision history

Group meetings:

1st meeting: Defined a very high level of what we want our application to be and what it will provide, by brainstorming scenarios and possible stakeholders’ needs and wants. Duration: 1.5h, 14/10/2020

2nd meeting: Defined scenarios and some key World and Shared Phenomena. We categorized the shared phenomena into World/Machine controlled.

Duration 1.5h, 17/10/2020

3rd meeting: Revised the R&DD document of the last year’s group.

Duration 1.5h, 24/10/2020

4th meeting: Defined Use Cases

Duration 1.5h, 14/11/2020

5th meeting: Defined Functional Requirements, Domain Assumptions and Goals  
Duration 2h, 21/11/2020

6th meeting: Reviewed Goals and defined all the External Interfaces  
Duration 1.5h, 25/11/2020

7th meeting: Reviewed Use Cases and defined new Requirements  
Duration 1.5h, 01/12/2020

1. Reference documents
2. Graphic demo of mobile application: <https://customerlineup.bubbleapps.io>
3. ISO/IEEE standards for the engineering of requirements for systems and software products: [https://standards.ieee.org/standard/29148-2018.html](https://standards.ieee.org/standard/29148-2018.html%20)
4. Document Structure

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1. OVERALL DESCRIPTION
2. Product perspective:
3. Scenarios
4. Hajsen wishes to buy groceries but remembers that the nearest market is small, and he would probably have to wait for an hour. Instead of going downstairs and waiting in line:

* He opens the app on his device and clicks on the button to “Get a ticket”
* He chooses the market he wants to go from a map
* The system shows the first available hour to enter the market
* Hajsen decides to go at that time and clicks on “Confirm”
* The system sends a notification to remind about his appointment, and Hajsen gets ready to go
* He arrives in the market in the assigned time and opens his app again
* He clicks on the “Show ticket” and scans it in the apposite machine
* After he finishes buying the groceries and paying for it, he opens the app and shows the ticket to the cashier
* Now he can exit the market

1. Giulio has just remembered that he promised to her fiancée a special dinner the following day. Since it is too late and he has no time to do the shopping, he decides to book a visit to the nearest supermarket to his home for the following day:

* He opens the app on his device and clicks on the button to “Book a visit”
* He selects the time he would want to go
* He selects the available supermarkets for the chosen time from a map
* The system asks Giulio an estimate of how much time his visit will last and a list of items (or categories of items) he intends to buy. Since Giulio has not a clear idea of what he will purchase and how much the visit will take, he clicks on “Confirm” leaving the two previous fields empty
* The system sends a notification to remind him the visit, so Giulio gets ready to go
* He arrives in the market in the assigned time and opens his app again
* He clicks on the “Show ticket” and scans it in the apposite machine
* After he finishes to do the shopping and paying for it, he opens the app and shows the ticket to the cashier
* He proceeds to exit the market

1. Shalini is the manager of one of the grocery shops of the chain “Ellelunga” and she wants to check on peak times how many people are entering inside the shop

* She opens the application on her device
* She presses on the button log in as manager
* She logs in with her credentials
* On the home page she sees the button “Statistics and Diagnostics” and presses it
* In front of her there are number of effective and expected entrances for the current week

1. Alberto B. hates technology, so he gambles his luck and tries to enter inside the market, unfortunately there are no available places to enter so he takes a ticket from the dispenser

* He gets to the ticket dispenser in front of the shop and presses the button to get a ticket
* Reading the ticket, he sees the time spot in which he can enter the market
* Since the time spot assigned is 2 hours later, he decides to do other things he had to do instead of queuing in front of the shop
* When the time is getting close to the appointment time, he gets back to the shop
* He retrieves the ticket from his pocket and scans it in the apposite machine, that lets him enter the market
* After he finishes buying the groceries and paying for it, he shows the ticket to the cashier
* Now he can exit the market

1. World and Shared phenomena details

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1. Class Diagram
2. Statecharts

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1. Product functions:
2. Functional Requirements:



The most important aspects of the system to be are the regulation and management of the entrances in stores as seen in the above scenarios.

The system to be should inform its users of what stores are available to go to and allow them to take a ticket and line up without needing to be in presence in front of the store.



1. User Characteristics

Virtual User: A person who has a smartphone or any smart device that can connect to the internet and the application as to virtually line up or book a visit. He will have to show the image of the ticket of his appointment in the right place in the entrance of the store.

Physical User: A person who goes directly to the shop and takes a ticket with the date and the time written on the card, from the dispenser. He will have to show the card of the ticket of his appointment in the right place in the entrance of the store.

Cashier: An employee of the shop who will provide with the correct scanning of the ticket before the exit of a Physical/Virtual User. If the market has a self check-out department, the turnstile will serve as the aforementioned employee.

Manager: An employee of the shop who is interested in checking the number of entrances or exits and in regulating them as needed. He will have the possibility to use our application for the statistics of entrances and exits.

1. Assumptions, dependencies and constraints

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| A1 | Users will take the shortest path to shops |
| A2 | User which specified a shopping list will spend 90% of their time within that visit in the departments related to the declared list |
| A3 | Data about store departments and items collocation in departments is correct |
| A4 | All store entrances and exits will have turnstiles gates |
| A5 | Users in stores will abide to local norms on social distancing |
| A6 | Only one person will enter the store per ticket |



1. SPECIFIC REQUIREMENTS
2. External Interface Requirements:  
   1. User Interfaces:
3. Graphical user interface, application

   Description automatically generatedMap

   Description automatically generatedMobile App, this must be easy to use, as it will have to be used from people of all ages, this means that the interface must be very minimal and direct. The app will allow virtual users to get a ticket, book visits, as well as monitor their tickets and visits, either if the virtual user has an account or not. If user does not login, the app will just consider him as a guest.   
   Here we can see some draft mockups[[1]](#footnote-1) with colours and graphics not optimized:

Shop selection

Home page of the app

Graphical user interface, text, application, chat or text message

Description automatically generatedQr code

Description automatically generatedDiagram

Description automatically generatedThe app will allow user to define first either the shop or the date and time, in the case of “Book a visit”, it is not shown in this demo because it is similar and irrelevant.

book a visit as registered user

book a visit as Guest

Ticket proposal

Ticket Confirmation

In the case of “book a visit”, after the shop selection, the app will allow registered users to select their shopping list:

1. Physical ticket dispensers, that will be installed in front of each shop, acting as proxies for the system. Physical ticket dispensers will allow physical users to get a ticket for the shop to which the dispenser belongs to.
2. Admin interface, that will be a more statistics-oriented panel, accessible through a desktop app (requiring an Authorized Account), that will allow the shop manager to login from an authorized device and monitor entrances and statistics as the average duration of a visit.   
   1. Hardware Interfaces:
3. Virtual Users must have a device that can download and run the app. To use all of the functionalities, as the notifications about the traveling time to a shop when the time is close to user’s turn, the device must have GPS turned on.
4. Dispensers must have a screen to display the first available time slot for a ticket and to ask for confirmation. There must also be two clearly distinguishable buttons for accepting or declining tickets, as to allow for an easy interaction with the customers.  
   1. Software Interfaces:
5. The system will need to access to some external APIs to access to maps, needed for user localization, user-to-store distance and time estimation and to find stores near a given address.
6. The system will require an interface with a memory storage unit to e
   1. Communication Interfaces:
7. Virtual user devices connect to the system via Internet.
8. Ticket dispensers can connect to system via ethernet cable or by a wireless connection.
9. Shop manager’s device connects to the system via Internet.
10. Functional Requirements:
11. Formal Functional Requirements

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| R1 | The system shall allow users to get a ticket with a date and time that shows when to go to a certain store virtually |
| R2 | The system shall allow users to get a ticket with a date and time that shows when to go to a certain store physically |
| R3 | The system shall allow users to book a visit virtually with their desired store, up to the next #7 upcoming days |
| R4 | The system shall allow users to look up on a map available stores where to go to |
| R5 | The system shall count the number of entrances and exits each day, for each market |
| R6 | The system shall store the number of entrances and exits for each market |
| R7 | The system shall allow users to be identified by their phone unique ID |
| R8 | The system shall allow users to be identified by a username of their choosing |
| R9 | The system shall allow store managers to regulate the number of entrances allowed in the store. |
| R10 | The system shall allow its users to insert information about which categories or items they want to buy. |
| R11 | The system shall infer how long it will take for customers to buy all products. |
| R12 | The system shall store data about registered users' habits of expenses. |
| R13 | The system shall inform users every 6 hours of the 10 closest stores' available time slots for the day. |
| R13.1 | The system shall allow its users to select which store(s) to get informed about, by default none |
| R13.2 | The system shall allow its users to select which time slots he is interested to get informed about, by default none |
| R14 | The system shall calculate how many people can stay inside the stores at any moment |
| R15 | The system shall ask users how much he or she thinks the trip will last |
| R16 | The system shall notify the user who has been inactive for 30 seconds while on the confirmation page of booking a ticket, on other available stores he could go to |

1. Use Cases
2. Virtual User’s registration

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| Actors | Virtual User |
| Entry condition | No entry condition |
| Events flow | 1. The user opens the CLup app on his smartphone and clicks on the “Create account” button. 2. The user fills all the mandatory fields. 3. The user clicks on the “Confirm” button. 4. The user receives a notification confirming the registration. |
| Exit condition | Virtual User’s data are saved into the database and the registration terminates successfully |
| Exceptions | 1. The user chooses an already registered username or email 2. The user does not fill one or more mandatory fields 3. The use inserts not valid information in one or more fields   For all the exceptions the system notifies the user that an error occurred. The Events flow starts again from point 2. |

1. Virtual User’s Login







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| Actors | Virtual User |
| Entry condition | The virtual user is already into the CLup app homepage |
| Events flow | 1. If the user wants to login as a guest, he directly selects either “Get a ticket” or “Book a visit” button, otherwise he inserts username and password into the “Username” and “Password” fields, respectively. 2. The user clicks on the “Login” button. 3. The system redirects the user to the CLup app homepage |
| Exit condition | The virtual user is successfully redirected to the CLup app homepage |
| Exceptions | 1. The virtual user clicks on the “Login” button but either the username or the password is wrong. The system notifies the user about the error. The Events flow starts again from point 1. |

1. Get Virtual Ticket

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| Actors | Virtual User |
| Entry condition | The virtual user is already logged into CLup app or he wants to access as a guest |
| Events flow | 1. The user selects the “Get a ticket” button. 2. The system redirects the user to a page where he can select the store where he would want to go (from a map). 3. The user selects a store from the map. 4. The system provides the first available time slot for the selected store. 5. The user clicks on the “Confirm” button. 6. The system notifies the user that the procedure has been successfully managed. 7. The system sends to the user the virtual ticket containing: 8. The user’s selected time slot. 9. The store’s name and address. 10. The QR code to enter (and exit) the store. |
| Exit condition | The user successfully receives the virtual ticket. |
| Exceptions | 1. The user refuses the provided time slot clicking on the “Cancel” button.   The system redirects the user to the homepage (Events flow starts again from event 1). |

1. Suggestion Alternative Stores (Get Virtual Ticket)



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| Actors | Virtual User |
| Entry condition | The virtual user is already logged into CLup app or he wants to access as a guest |
| Events flow | 1. The first four events are the same of the “Get Virtual Ticket” use case. 2. The user remains inactive for 30 seconds. 3. The system notifies to the user the possibility to check among a list of further suggested stores. 4. The user clicks on the received notification. 5. The system provides to the user a list with further available stores with an available time slot preceding the already provided one. |
| Exit condition | The user successfully receives the list of further suggested stores. |
| Exceptions | 1. The user clicks on the “Confirm” button without being inactive 30 seconds.   The Events flow proceeds from event 6 of “Get Virtual Ticket” use case.   1. The user does not click on the notification.   The user can only confirm or reject the provided time slot for the selected store (the Events flow proceeds from event 5 of “Get Virtual Ticket” use case). |

1. Book Visit

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| Actors | Virtual User |
| Entry condition | The virtual user is already logged into CLup app or she wants to access as a guest |
| Events flow | 1. The user selects the “Book a visit” button. 2. The system redirects the user to a page where she can select the time slot or the store where she would want to go (from a map) 3. The user selects the time slot, the system provides, through the map, the first 10 available stores closest to the user’s current position. 4. The user selects a store from the map, the system provides the list of available time slots for the next 7 days. 5. The user selects either a store from the map (case a) or a time slot (case b), then she clicks on the “Confirm” button. 6. The system redirects the user to a page where she can indicate the approximate expected duration of the visit, the exact list of items and the categories of items she intends to purchase. 7. The user optionally fills the previous fields, then she clicks on the “Confirm” button. 8. The system notifies the user that the procedure has been successfully managed. 9. The system sends to the user the virtual ticket containing: 10. The user’s selected time slot. 11. The store’s name and address. 12. The QR code to enter (and exit) the store. |
| Exit condition | The user successfully receives the virtual ticket. |
| Exceptions | 1. The user clicks on the “Cancel” button.   The system redirects the user to the homepage (Events flow starts again from event 1).   1. The user’s GPS is unavailable (case 3.a).   The system asks the user to insert an address and provides the 10 available stores closest to the user’s address (Events flow continues from event 4). |



1. Suggestion of Alternative Time Slots (Book visit)



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| Actors | Virtual User |
| Entry condition | The virtual user is already logged into CLup app or she wants to access as a guest |
| Events flow | 1. The first three events are the same of the “Book visit” use case (the user selects a store: case 3.b). 2. The user remains inactive for 30 seconds. 3. The system notifies to the user the possibility to check available time slots of further suggested stores. 4. The user clicks on the received notification. 5. The system provides to the user a list of available time slots of further suggested stores close to selected one. |
| Exit condition | The user successfully receives the list of available time slots. |
| Exceptions | 1. The user selects a provided time slot without being inactive 30 seconds.   The Events flow proceeds from event 5 of “Book visit” use case.   1. The user does not click on the notification.   The user can select only the initial provided time slots (the Events flow proceeds from event 4 of “Book visit” use case). |

1. Suggestion of Alternative Stores (Book visit)

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| Actors | Virtual User |
| Entry condition | The virtual user is already logged into CLup app or she wants to access as a guest |
| Events flow | 1. The first three events are the same of the “Book visit” use case (the user selects a time slot: case 3.a). 2. The user remains inactive for 30 seconds. 3. The system notifies to the user the possibility to lookup further available stores for the selected time slot. 4. The user clicks on the received notification. 5. The system provides to the user a list with further available stores. |
| Exit condition | The user successfully receives the list of further available stores. |
| Exceptions | 1. The user selects a provided store without being inactive 30 seconds.   The Events flow proceeds from event 5 of “Book visit” use case.   1. The user does not click on the notification.   The user can select only the initial provided stores (the Events flow proceeds from event 4 of “Book visit” use case). |

1. Periodic Notification of Time Slots

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| Actors | Virtual User |
| Entry condition | The virtual user is already logged into CLup app or she wants to access as a guest |
| Events flow | 1. The user accesses the notification panel. 2. The user selects one or more stores she wants to be notified about. 3. The user selects a day or a time range. 4. The user selects how often she wants to be notified. 5. The user clicks on the “Confirm” button. 6. The system notifies the user that the procedure has been successfully completed. |
| Exit condition | The user’s notification preferences are correctly updated. |
| Exceptions |  |

1. Monitor Entrances



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| Actors | Store Manager |
| Entry condition | The store manager access CLup app through an authorized account. |
| Events flow | 1. The store manager selects a store between those he manages. 2. The system redirects the store manager to a page where he can: 3. See the statistics about entrances of the selected store. 4. Regulate the influx of people entering the store by setting a parameter. |
| Exit condition | The store manager can see the statistics and regulate the influx of people entering the selected store |
| Exceptions |  |

1. Performance Requirements:

On the basis of studies done by ISTAT on the Italian number of population and by the US government on the habits of customers of grocery shops (references in point 6 of document), we extract some main points needed on the calculation of the performance requirements. These main points are:

* + 1. There are around 750 thousand families in Milan only.
    2. There are around 25 million families in Italy.
    3. On average Saturday sees more families go grocery shopping (from 10% to 40% more)
       1. In the US from 29-30 million go on a weekday, while on the weekend 33-41 million families go grocery shopping
    4. The average family goes grocery shopping 1.6 times a week as of 2019

Based on this information we can deduce that on the worst case the system to be will have to manage on peak hours 360 thousand users contemporarily in one hour in Italy.

Since it is important to have fast responses to users’ requests, a response time to any request, comprising those of the external API’s should be under 0.5 seconds.

1. Design Constraints:  
   1. Software Compliance:

The software will comply with local laws regarding COVID-19 and its’ safety related regulations.

Furthermore, the software will comply with local laws about data treatment and usage such as the EU General Data Protection Regulation [GDPR 2016/679](https://eur-lex.europa.eu/legal-content/EN/AUTO/?uri=CELEX:02016R0679-20160504&qid=1532348683434).

* 1. Hardware Limitations:

There are inherent hardware limitations in which the system will find itself.

For example, the dispenser will only have two buttons and a non-touch screen so the system cannot be much interactive.

It is important for the software to be designed in a way that keeps count of its’ portability. This way it will need to be run on computationally weak (old) devices too.

1. Software System Attributes:  
   1. Reliability:

The system will have to handle up to 10% more requests with respect to the worst-case scenario defined in the Performance Requirements section.

* 1. Availability:

Because of the system’s importance on the provision of social distancing for one of the most crucial aspects of our lives, it will have to be up for 99.9% of the time. (Downtime: less than 9 hours)

* 1. Security:

Security is important for the sole reason of the registered users’ passwords that will have to be stored. Since these passwords might be shared with other applications or programs with more sensitive data, the passwords should be encrypted with up-to-date technologies and stored in a system with salt values. All data should be stored in compliance with GDPR’s regulation.

* 1. Maintainability:

The system-to-be has a strong need of maintainability and extendibility because of its nature.

* 1. Portability:

Since the goal is to make it easy for all people to use our system-to-be, it must be operatable in different operating system environments.

1. FORMAL ANALYSIS USING ALLOY
2. EFFORT SPENT
3. REFERENCES

* How often families go grocery shopping per week : <https://www.statista.com/statistics/251728/weekly-number-of-us-grocery-shopping-trips-per-household/>
* How many families are there in Milan: <https://www.tuttitalia.it/lombardia/18-milano/statistiche/popolazione-andamento-demografico/>
* Which day is the busiest for grocery shopping: <https://www.forbes.com/sites/joanverdon/2020/04/08/best-time-for-grocery-shopping-tips-from-in-store-traffic-data/#:~:text=The%20busiest%20days%3F,box%20stores%2C%E2%80%9D%20he%20said.>
* How many families go grocery shopping on weekends in respect to weekdays: <https://www.insider.com/best-time-to-go-grocery-shopping-2018-3>
* How many families are there in Italy: <https://www.istat.it/it/files/2018/12/C03.pdf>

1. Mockups are taken from an interactive graphic demo with graphic-driving purposes only, linked in the “reference documents” paragraph. [↑](#footnote-ref-1)