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Travlendar+ project Neroni, Pozzi, Vetere

Design Document

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1 Introduction

1.1 Purpose

The purpose of this document is to provide more technical and detailed information about the software discussed in the RASD document. It will represent a strong guide for the programmers that will develop the application considering its different parts: the basic service and the two advanced functions. In this DD we present hardware and software architecture of the system in terms of components and interactions among those components. Furthermore, this document describes a set of design characteristics required for the implementation by introducing constraints and quality attributes. It also gives a detailed presentation of the implementation plan, integration plan and the testing plan. In general, the main different features listed in this document are:

- The high-level architecture of the system
- Main components of the system
- Interfaces provided by the components
- Design patterns adopted

Stakeholders are invited to read this document in order to understand the characteristics of the project being aware of the choices that have been made to offer all the functionalities also satisfying the quality requirements.

1.2 Scope

Clup is an application that aims to avoid users from crowding outside supermarkets when doing grocery shopping in pandemic times.

The application can be used both by store customers and store managers. On one hand users can virtually queue by Clup to enter the supermarket and they are provided with real time information about the line, in this way they can arrive at the entrance only when they are allowed to enter. On the other hand the application monitors and stores the information about people fluxes; this data is then provided to store managers who can take actions depending on the situation. The few paragraphs just read represent an overview of the main functionalities offered by the system: more detailed information can be found on the RASD document.

1.3 Definitions, Acronyms, Abbreviations

1.3.1 Definitions

1.3.2 Acronyms

1.3.3 Abbreviations

1.4 Revision history

1.5 Reference Documents

1.6 Document Structure

- Chapter 1 describes the scope and purpose of the DD, including the structure of the document and the set of definitions, acronyms and abbreviations used.
- Chapter 2 contains the architectural design choice, it includes all the components, the interfaces, the technologies (both hardware and software) used for the development of the application. It also

includes the main functions of the interfaces and the processes in which they are utilised (Runtime view and component interfaces). Finally, there is the explanation of the architectural patterns chosen with the other design decisions.

- Chapter 3 shows how the user interface should be on the mobile and web application.
- Chapter 4 describes the connection between the RASD and the DD, showing the matching between the goals and requirements described previously with the elements which compose the architecture of the application.
- Chapter 5 traces a plan for the development of components to maximize the efficiency of the developer team and the quality controls team. It is divided in two sections: implementation and integration. It also includes the testing strategy.
- Chapter 6 shows the effort spent for each member of the group.
- Chapter 7 includes the reference documents.

2 Architectural Design

2.1 Overview

CLup's architecture is layered as follows:

- **Presentation layer** (P) handles the interaction with users. It contains the interfaces able to communicate with them and it is responsible for rendering of the information. Its scope is to make understandable the functions of the application to the customers.
- **Application layer** (A) takes care of the functions to be provided for the users. It also coordinates the work of the application, making logical decisions and moving data between the other two layers.
- **Data access layer** (D) which takes care of the information management, database access control. It also handles data retrieval and passes them to upper level layers.

The architecture style chosen for CLup is the **multi-tier** one. As previously anticipated in the Requirements Analysis and Specifications Document, there will be at least one server for each one of the following interest areas:

- Bookings
- Queues
- Notifications
- Stores
- Staff members
- Customers

This is mainly done to distribute workload as well as making the overall system more robust.
There will be also at least two servers for the two following functionalities:

- Customer related functionalities
- Staff related functionalities

The bookings, queue and notifications databases will be distributed and replicated all over the entire store list. Each store will have its own instance of bookings, queue and notifications database while a central logic server will act as a request redirector towards them whenever needed.

In Figure 1 is represented the high-level architecture of the system: customers clients, through an internet connection, can connect to Clup's Web Servers.Client's operations are redirected by Web Servers to the Central Customer Operations Manager, who represents the A layer of the customers' side, and, depending by the kind of information, stored or retrieved on the Customers Database or in one of the three local store databases: Bookings, Notifications, Queue. Staff clients instead are connected through a LAN connection to their Local Web Server, who will redirect their requests to the Staff Operations Manager server. This machine is expected to process the logic of requests and then submit them to the Local Application Logic server who will decide in which database store or retrieve the information. Local Application Servers are connected to the Central Customer Operations Manager as well through an internet connection.

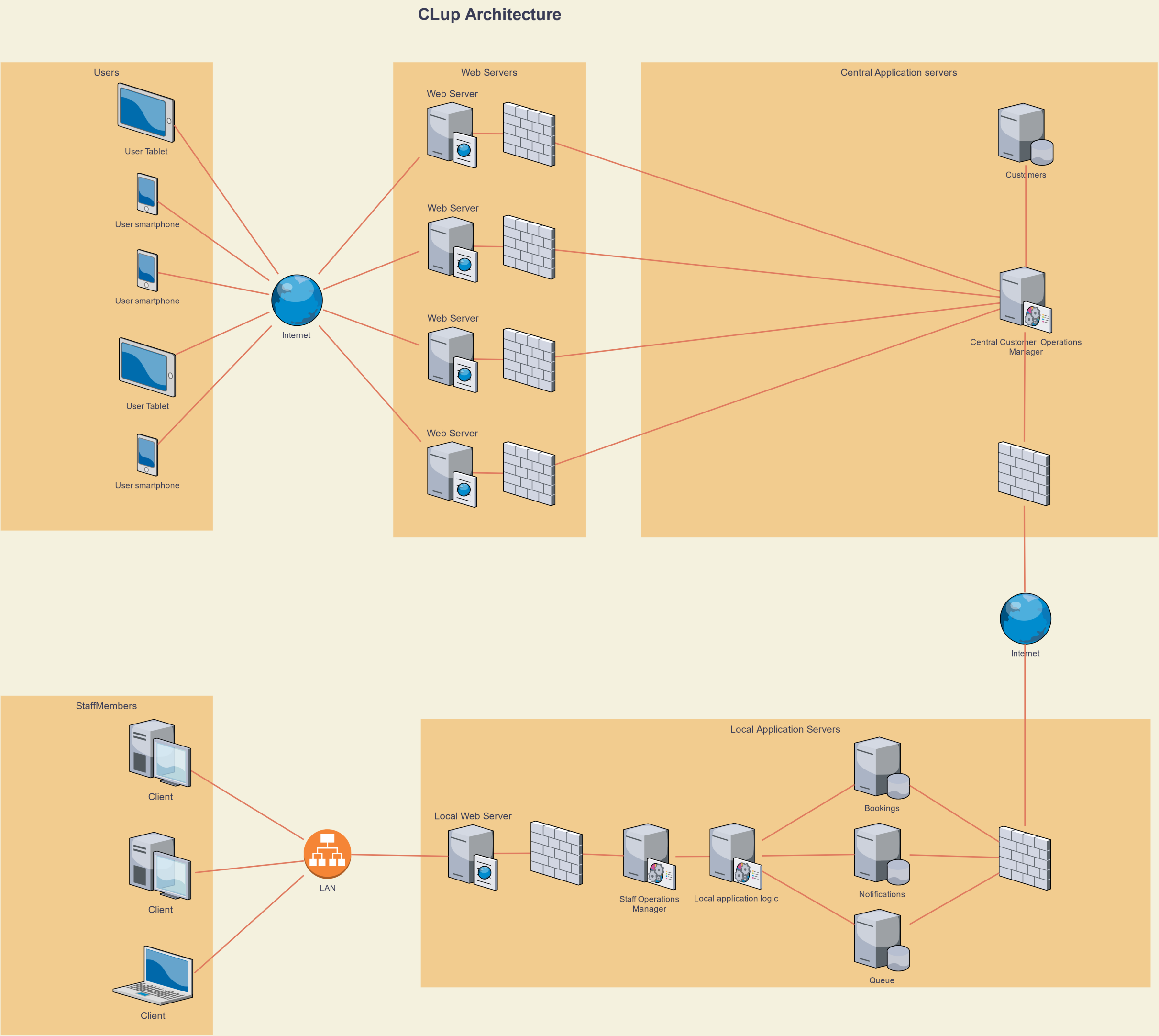


Figure 1: High-level architecture

2.2 Component view

In Figure 2 is represented the component diagram of the internal structure of the application server **TODO: ci sono diversi A server, di conseguenza bisognerebbe dividere il component diagram**, showing how its components interact. The application server contains Clup's business logic. What follows is a brief description of every component:

- **Staff Web Services**: this component is made of two subcomponents that provide logic and interface to the web application used by store managers:
  - **Store Manager**: This component is responsible for the subscription and the unsubscription
  - **Store Activity Manager**:This component provides the information about people fluxes and the functionalities provided to store managers
- **Customer Services**: This component has a subcomponent **Service Redirector** that, depending on the the customer's request, forwards it to the right interface
- **Queue Services**: This component aims at managing and updating supermarket's lines

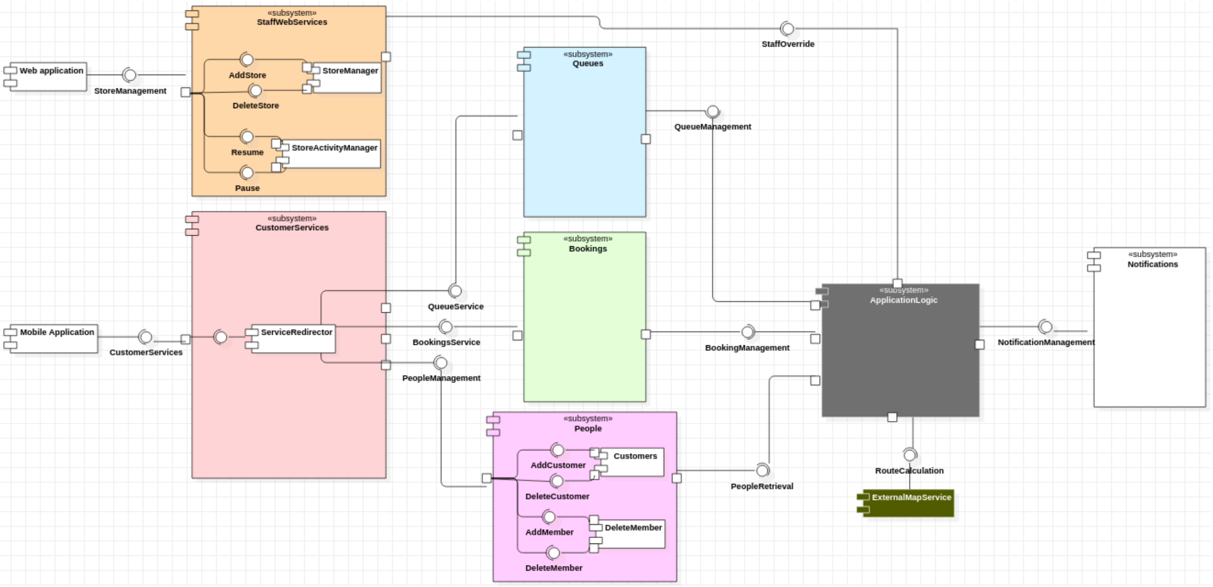


Figure 2: Component Diagram

- **Bookings Services**: This is the component who manages customer's bookings and store's calendar and slots
- **User Services**:This component has two subcomponents:
  - **Customers**: Here the logic of Clup handles customer information
  - **Staff**: Here Clup's logic handles Staff information
- **Application Logic TODO: change this name**:
- **External Map Services**: This is the component that provides the map interface

Nearly every component interacts with the database system to store or retrieve the information.

2.3 Deployment view

2.4 Runtime view

2.5 Component interfaces

2.6 Selected architectural styles and patterns

2.7 Other design decisions

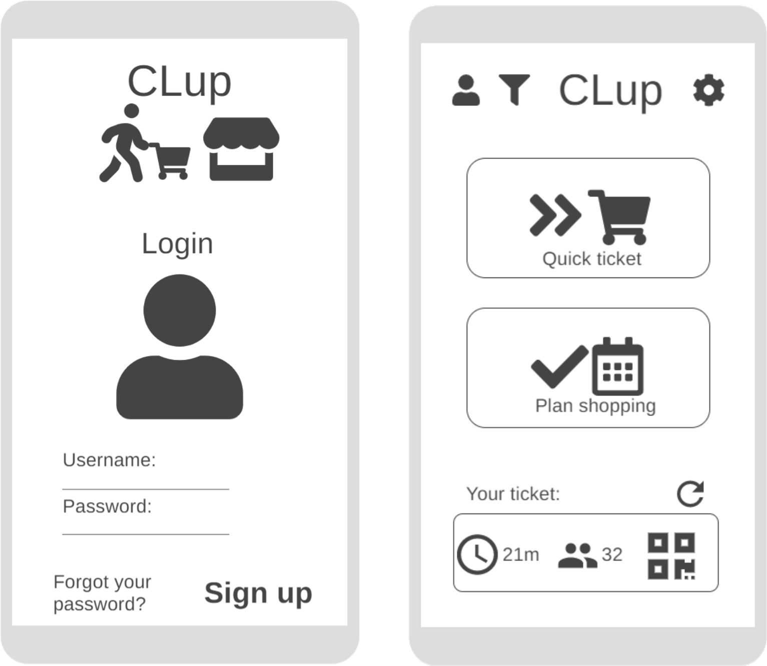
3 User Interface Design

3.1 Overview

CLup is an application aimed at decreasing the probability of contracting COVID-19 (diseases in general) when going shopping to a supermarket. There are two fundamental components: the main one targets customers of supermarkets while the second one is available for store managers.

3.1.1 User Interfaces

End user functionalities Regarding the first target - customers - they will be required to register to the service the first time they use it by inserting their full name, email address, ID card, phone number and a password. The customer will also be requested to specify his physical address, or to enable the GPS, in order to allow CLup to find stores nearby; this last information can be changed anytime the user needs. If the customer is not willing to register or share his address, the service will not be available.

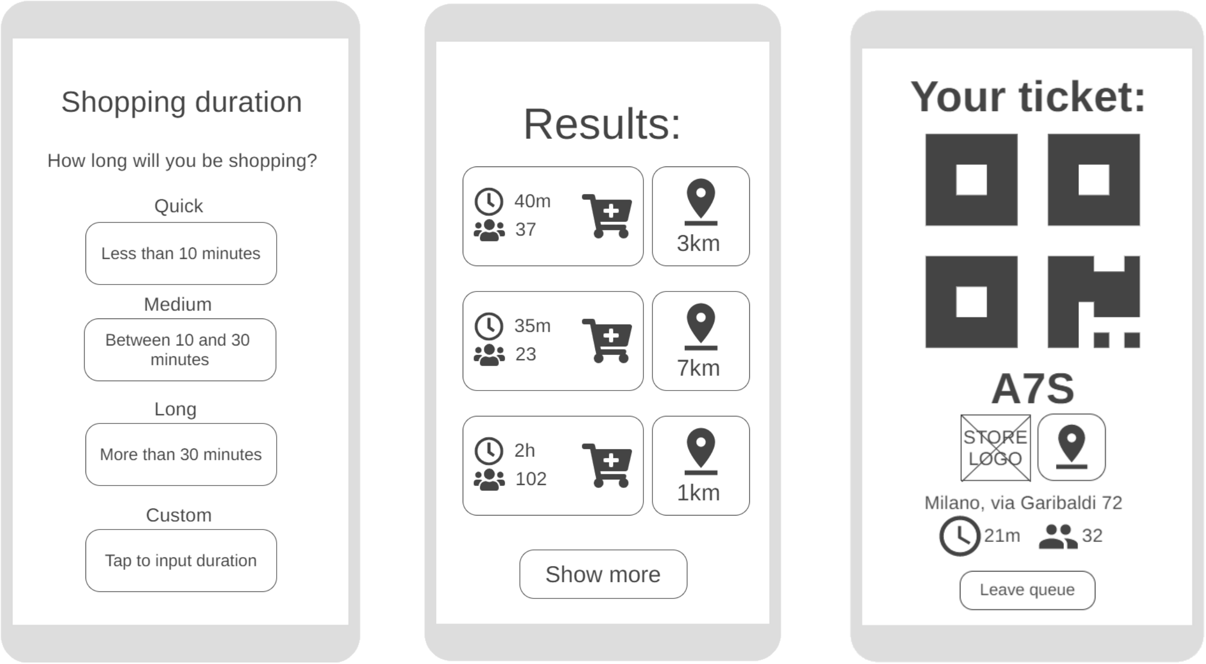


(a) Login screen

(b) Main screen

Figure 3: App startup

Once the setup is done, customers will be able to access the homepage of the application, where they can tap on the "Quick ticket" button that will allow them to see a list of stores inside a specified range from their current location: for each store a distance in kilometers from the user position will be outlined, as well as the number of people inside the store and its maximum capacity; whenever a store is full, the current number of people in line and an *EWT* are displayed.
It is also possible to visualize stores on a map and, by tapping on one of them, to see the same information displayed in the list. Now, if the user chooses to reserve a spot in the line, the application will open a confirm dialog specifying EWT and the expiration of the ticket. If the user refuses nothing happens, if he accepts instead CLup will process the request, show his ticket and the real time evolution of the line; the ticket is also visible from the home screen.
The tickets consist of a QR code and an easy to remember alphanumeric code alternative to enter the store. At the stores entrances there will also be monitors that show the numbers allowed to enter and,



(a) Shopping time

(b) Store list

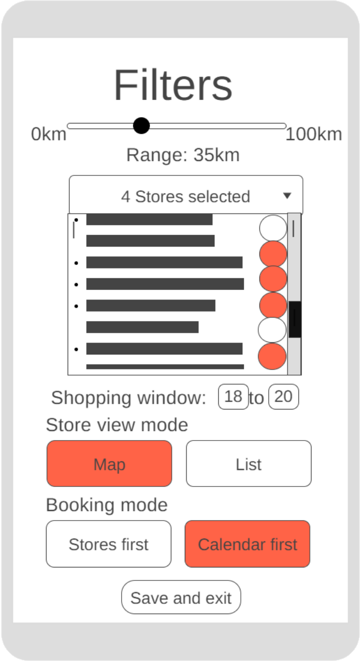
(c) Your ticket

Figure 4: Quick ticket procedure

eventually, delays.

The distance range in which CLup will look for supermarkets is specified by the user through the filter button in the homepage, this button will in fact open the filter screen in which, among other parameters, a sliding bar controls the distance and a drop-down list allows the user to filter the chains of supermarkets.

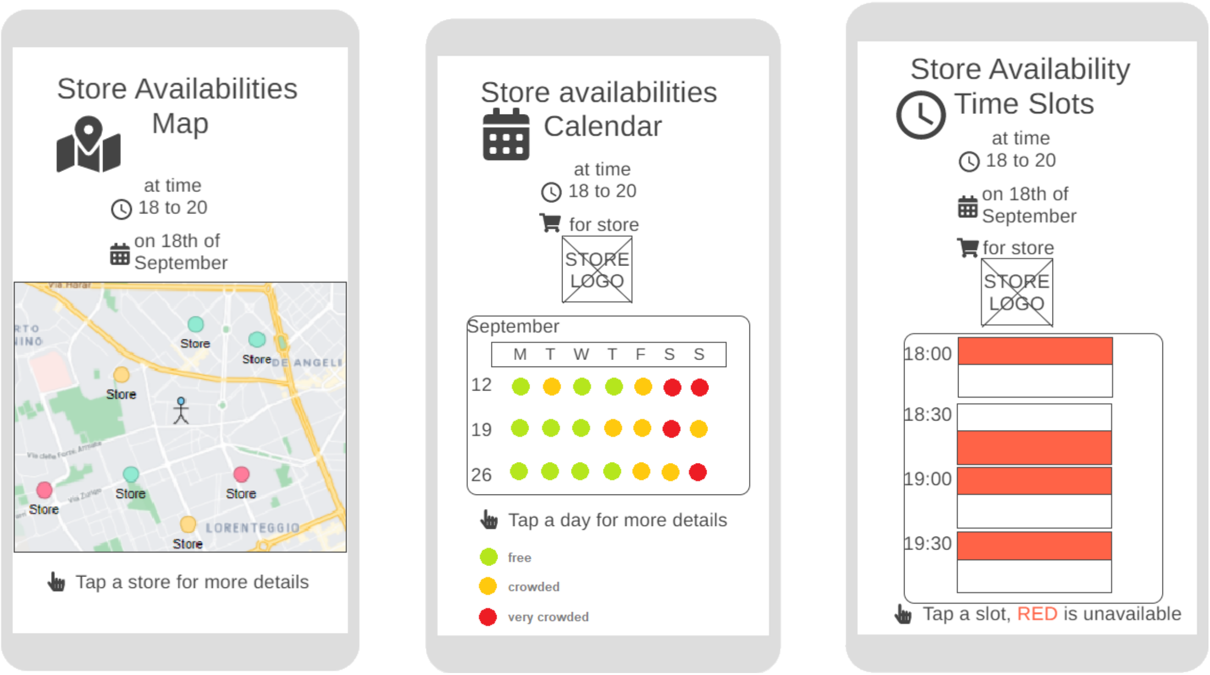
Another important feature is the possibility to book an entrance later in the day or in another day. The



(a) Filters screen

Figure 5: Filters

user can specify from the filters whether he prefers to choose the day or the store first and he can set the time range in which he wants to book. There is a dedicated button in the app's main screen that redirects the user to either the list/map of supermarkets or the calendar, and once the user chooses he will be respectively shown the calendar or the list/map, this time with colours to indicate the average crowdedness of stores/days given the set time range. When the user chooses the day and supermarket combination, a timetable spanning the chosen time range is shown, divided in 15 minutes time slots each one marked to show its availability. The user will be able to check his reservation on the home page exactly like previously for the quick ticket, and near the entrance time he will be provided an actual ticket.



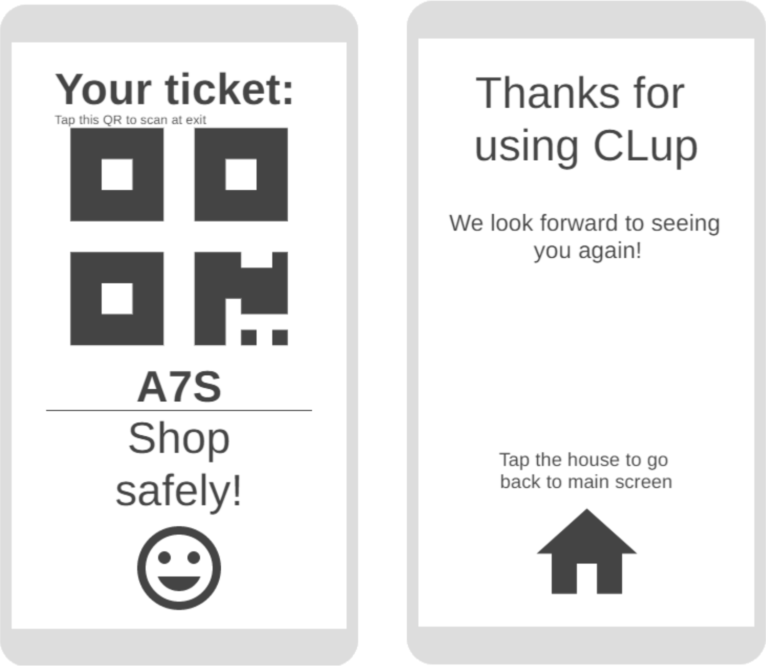
(a) Map screen

(b) Calendar screen

(c) Time slot choice

Figure 6: Booking procedure

The access at the supermarket is restricted by turnstiles with QR code readers, a staff member is expected to verify that nobody waits his turn in front of the entrance, jumps the turnstile or does anything irresponsible. During the shopping the user will still be able to view his ticket in order to use it to unlock the turnstile upon exiting the store. Customers who, for any reason, do not use the app will still be able to



Your ticket:

Tap this QR to scan at exit

A7S

Shop safely!

Thanks for using CLup

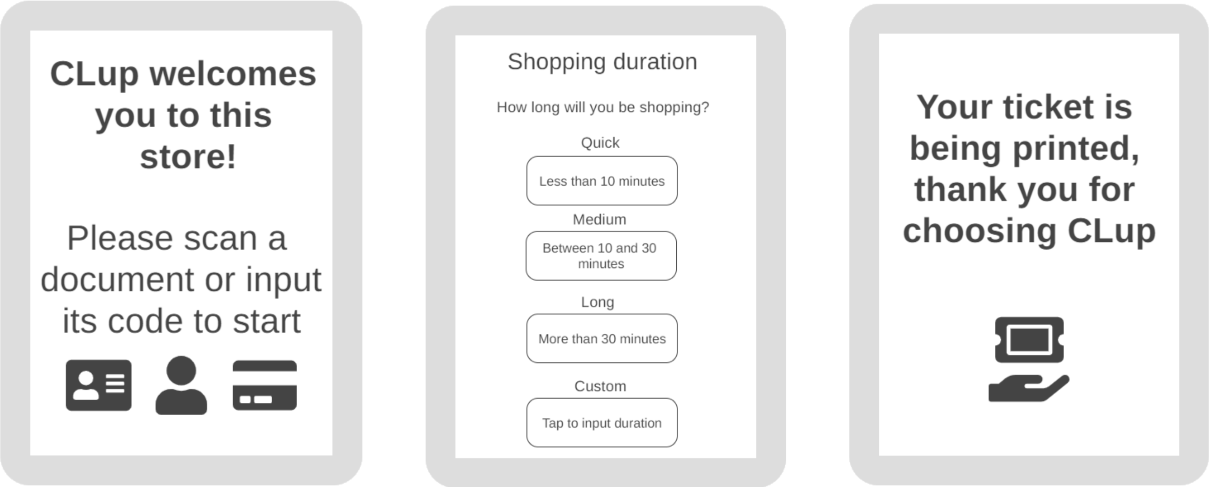
We look forward to seeing you again!

Tap the house to go back to main screen

(a) Shopping screen (b) Exit screen

Figure 7: Shop and exit

queue in CLup supermarkets by obtaining a printed ticket from a physical totem located near such stores; the functioning of the application will be similar to the “Quick ticket” app function with the difference that the user can only obtain a ticket for the current totem’s store.



CLup welcomes you to this store!

Please scan a document or input its code to start

Shopping duration

How long will you be shopping?

Quick

Less than 10 minutes

Medium

Between 10 and 30 minutes

Long

More than 30 minutes

Custom

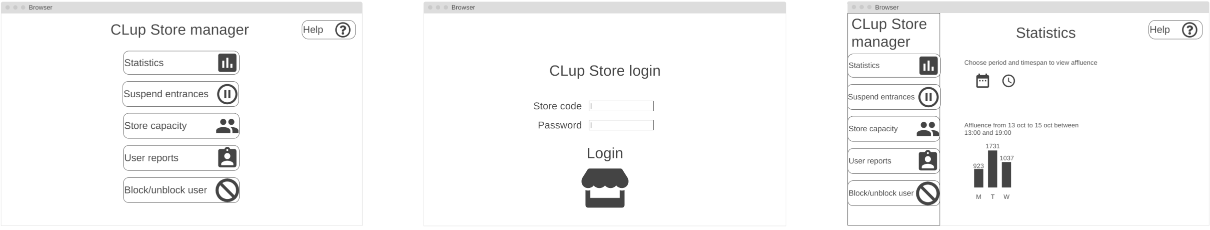
Tap to input duration

Your ticket is being printed, thank you for choosing CLup

(a) Totem welcome screen (b) Totem shopping time input (c) Totem print screen

Figure 8: Totem ticket procedure

Internal use functionalities Another component of CLup targets store managers: when the store decides to join the CLup network, ad-hoc credentials to access the web app will be given. Special staff-only functions will then be achieved by the use of a web application, accessible via internal-use terminals.



Choose period and timespan to view affluence

Affluence from 13 oct to 15 oct between 13:00 and 19:00

(a) Manager login

(b) Manager main screen

(c) Manager statistics screen

Figure 9: Store manager web app

4 Requirements Traceability

G1	**Anybody is guaranteed possibility to make shopping at any supermarket in reasonable time (def. reasonable)**
	Requirements: R1, R6, R7, R10, R15,R23
	Components: • a • b

Table 1: G1 Mapping

G2	**Users can get to know the least crowded time slots**
	Requirements: R2, R11, R12, R18, R21
	Components: • a • b

Table 2: G2 Mapping

G3	**Fair users can make a reservation to enter in a supermarket**
	Requirements: R9, R13, R15, R21, R23
	Components: • a • b

Table 3: G3 Mapping

G4	**Stores can easily monitor fluxes**
	Requirements: R3, R11, R22
	Components: • a • b

Table 4: G4 Mapping

G5	**Only authorized users can access**
	Requirements: R4, R6, R13, R15, R19
	Components: • a • b

Table 5: G5 Mapping

G6	**Crowds are dramatically reduced outside supermarket stores**
	Requirements: R1, R2, R5, R6
	Components: • a • b

Table 6: G6 Mapping

G7	**CLup should not decrease customer affluence beyond a reasonable level w.r.t. to normal (define reasonable)**
	Requirements: R1, R5, R6, R7, R9, R10, R20, R21, R23
	Components: • a • b

Table 7: G7 Mapping

G8	**Same shopping capabilities guaranteed to offline users**
	Requirements: R1, R7, R10
	Components: • a • b

Table 8: G8 Mapping

G9	**Find the best (less crowded, soonest available) alternative among local supermarket stores**
	Requirements: R3, R11, R12, R20
	Components: • a • b

Table 9: G9 Mapping

G10	**Supermarkets do not overcrowd**
	Requirements: R2, R3, R4, R11, R12, R20
	Components: • a • b

Table 10: G10 Mapping

R1	Every user can generate a quick ticket for any store
R2	Whenever user makes initiates a booking procedure, CLup must be able to compute a suggested least crowded time slot based on historical data
R3	CLup must elaborate and upload data about current global customer affluence to the store during use
R4	CLup must admit only valid QR codes for entrance
R5	CLup must allow users to know current queue status
R6	CLup must update user on tickets' validity change
R7	CLup must inform offline users about new tickets (un)availability
R8	CLup must allow users to indicate which product category they are going to purchase while booking
R9	CLup must suggest alternative stores when the combination of selected store|time gives no results
R10	CLup must reserve a non null number of paper tickets at any time for offline customers use
R11	CLup must gather all stores' data about entrance fluxes
R12	CLup is able to cross affluence data of any supermarket
R13	CLup keeps track of people who book an entrance and don't come
R14	CLup allows store managers to stop quick tickets availability
R15	CLup is able to generate QR codes
R16	CLup is able to authenticate users
R17	CLup is able to store users' data
R18	CLup is able to process users' data
R19	CLup makes quick ticket invalid after 15 minutes delay
R20	CLup can use stores' data to sort every store by crowdedness
R21	Users can see available day/time slots of a supermarket through CLup
R22	CLup shows to store managers flux data about their supermarket
R23	CLup must be able to process reservations

Table 11: Requirements list

5 Implementation, Integration and Test Plan

5.1 Implementation

5.2 Integration

5.3 Test Plan

6 Effort Spent

References