RASD document

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# Introduction

## Purpose

In this document will be presented a description of the SafeStreets application – from now on referred to as the system – along with the analysis of its goals, its requirements and the assumptions taken.

### Problem overview

The system is addressed to two different types of entities: the subscribed user and the municipality.

The system will allow the users to send reports (including a picture, time, date, position and type) about traffic violations. The gathered data will be elaborated (plate recognition if the plate number is not provided, street name) and used to show to users and the municipality the streets or areas with the highest frequency of violations; in addition the municipality will have access to a list of the plate numbers of the vehicles that committed the most violations and to suggestions for possible interventions.

The system will be able to collect data from the municipality about violations on the territory, crossing it with the data from user reports and using it as above. This will be referred to as the data integration service[[1]](#footnote-1).

The municipality will have access to a list of suggested infrastructural interventions, based on the received reports. This will be referred to as the suggestion service.

The system will also provide a way for the municipality to access the data from user reports, to allow the generation of traffic tickets; the data from the generated traffic tickets will be used for building statistics (on the person with most tickets and the trends in the issuing of tickets) accessible by the municipality together with the other insights. Care must be taken to ensure that the chain of custody is never broken. This will be referred to as the access reports service*[[2]](#footnote-2)*.

### Goals

These are the goals of the SafeStreets system:

* G1: The System accepts reports by the users about the valid parking violations.
* G2: The System suggests possible interventions to the Municipality.
* G3: The System allows the Municipality to retrieve submitted parking violations.
* G4: The System gives some statistics to the User about the violations.
* G5: The System gives all statistics to the Municipality about the violations.
* G6: The System can retrieve the violations verifiedby the Municipality.

## Scope

Here it is presented the initial distinction between events that belong to the world and those that belong to the machine (the system). The violations and the event user finds a violation are considered part of the world. Indeed, the machine is not aware of these events unless the user sends a report notifying the violation and its location, which are shared events. Likewise, are part of the shared phenomena the events in which the users or the municipality access the statistics and the municipality accesses the violations and the suggestions, the systems accesses data on violations from the municipality and vice versa. The machine side of the model contains the data memorized, the process of data analysis and the process of plate recognition.

Traffic violation

Municipality makes traffic tickets

User finds violation

Violation memorization

User memorization

Plate recognition

Data analysis

User notifies a violation

Municipality accesses violations

Suggest intervention

**WORLD**

**MACHINE**

Detecting violation’s position

User or municipality requests statistics

Access to traffic tickets of municipality

The next table identifies the most important shared phenomena.

|  |  |  |
| --- | --- | --- |
| **Phenomenon** | **Shared** Y=Yes N=No | **Who controls it** W=World M=Machine |
| A car makes a traffic violation | N | W |
| The User sees the traffic violation | N | W |
| The User wants to report the violation | N | W |
| The User reports the violation | Y | W |
| The User takes a picture and adds it to the report | Y | W |
| The User insert in the report the position of the violation | Y | W |
| The User insert in the report the license plate of the car | Y | W |
| The machine calculates the position of the violation | N | M |
| The machine identifies the license plate of the car | N | M |
| The User indicates the type of the violation | Y | W |
| The User wants to contribute to the safe of the streets | N | W |
| The User registers himself/herself in the machine | Y | W |
| The User inserts the copy of his/her identity card | Y | W |
| The User inserts his/her information (e.g. firstname, lastname, address) | Y | W |
| The machine checks the identity card of the User | N | M |
| The machine accepts or rejects the registration of the User | Y | M |
| The User makes the login in the machine | Y | W |
| The User inserts his/her username and password | Y | W |
| The machine checks the username and the password | N | M |
| The machine accepts or rejects the username and the password | Y | M |
| The User wants to see some statistics on the machine | N | W |
| The User selects some statistics | Y | W |
| The machine calculates the statistics asked by the User | N | M |
| The machine shows the calculated statistics to the User | Y | M |
| The Municipality wants to make safer its streets | N | W |
| The Municipality asks for the registration to the employees of the  SafeStreets company | N | W |
| The employees of the SafeStreets company register the Municipality | Y | W |
| The Municipality makes the login in the machine | Y | W |
| The Municipality inserts its username and password | Y | W |
| The employees of SafeStreets ask the Municipality to allow the machine  to access to its violations | N | W |
| The Municipality offers to the machine a method to access to its  violations | Y | W |
| The machine accesses the violations of the Municipality | Y | M |
| The Municipality wants to see some statistics on the machine | N | W |
| The Municipality selects some statistics | Y | W |
| The machine calculates the statistics asked by the Municipality | N | M |
| The machine shows the calculated statistics to the Municipality | Y | M |
| The Municipality wants to verify the last violations | N | W |
| The Municipality takes from the machine the last violations | Y | W |
| The Municipality verifies the violations taken from the machine and it  generates traffic tickets from them | N | W |
| The machine calculates possible interventions | N | M |
| The machine suggests the Municipality some interventions | Y | M |

The world in which the system will work is modelled as follows: all the authorities that oversee the viability or can generate traffic tickets are considered as one for simplicity and are referred to as municipality. The municipality is not a mandatory actor, the system can work fine even without any.  
The user is a person that is subscribed to the system; his identity is verified, for this reason he is considered trustworthy: he does not send false or wrong reports. The users interact with the system mainly through a mobile device.

The system is considered to be supported by an organization of some kind, which handles the infrastructure necessary for the operativity and any contracts with the municipalities.

The data provided by the municipality is given for accurate and timely. All the services provided by third parties are supposed to be trustworthy: if they provide a result without error, then the result is correct.

## Definitions, acronyms, abbreviations

### Definitions

* SafeStreets: the software to be
* System: the software to be
* Machine: the software to be
* User: the end user, a registered and logged in individual who can send reports and access statistics
* Municipality: the authority that oversees the viability in the area and generates tickets, to use the functions must be registered and logged in
* (Traffic) Violations: all types of traffic violations punishable by law, e.g.: parking on bike lanes or reserved lots, double parking
* Report: an alert from a user about a traffic violation
* Effectiveness of the system: the trend of the number of received reports in a given area

### Acronyms

* API: Application Programming Interface
* GPS: Global Positioning System; for which is intended also equivalent systems such as GALILEO
* UI: User Interface
* S2B: Software to Be

### Abbreviations

* G*n*: *n*th goal
* D*n*: *n*th domain assumption
* R*n*: *n*th requirement

## Revision history

* Version 1.0 First version of the document.

## Document structure

The RASD document comprises six chapters:

**1. Introduction**:

**2. Overall Description:**

**3. Specific Requirements:**

**4. Formal Analysis using Alloy:** it contains the model, described using the formal language Alloy, of the most critical parts of the system and of the environment. This chapter contains also some worlds obtained from the model and the checks of some assertions.

**5. Effort Spent:** It contains the number of hours used by each member of the group to work on each part of the document.

**6. Reference Documents:** It contains the documents used to write this document.

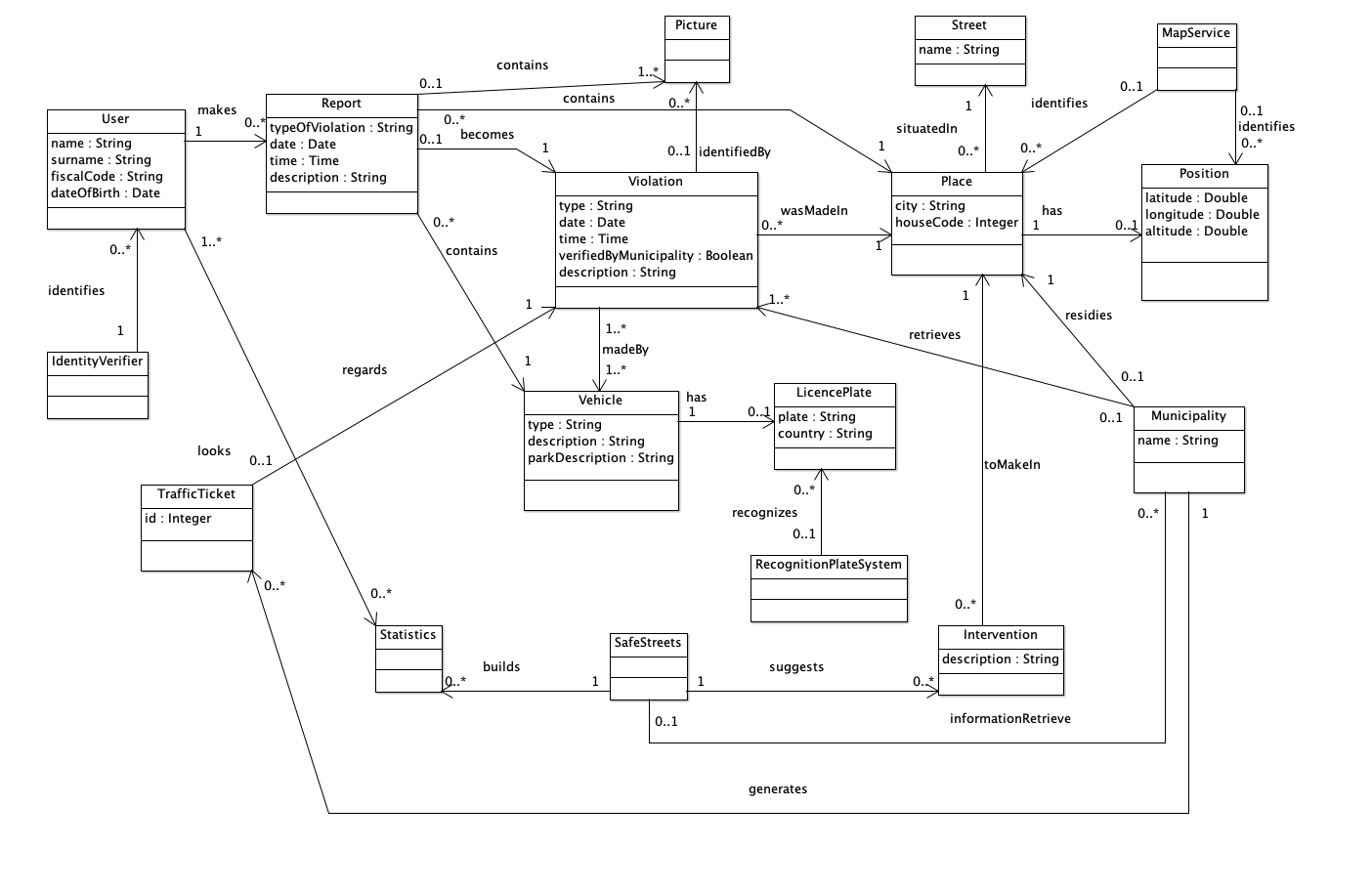
# Overall description

## Product perspective

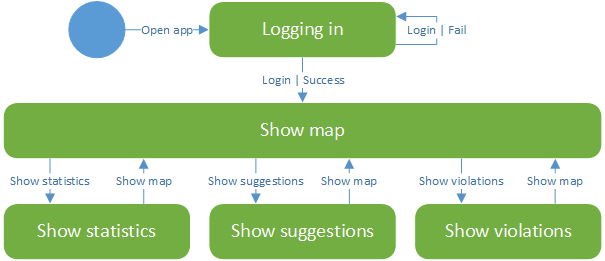
The system is divided into three products: a software for the user (mainly used on mobile devices), a software for the municipality and one for the system’s backend.

The report will contain the date, the time, one or more pictures with the main one containing the license plate number, which will be recognized by the system if not inserted by the user, the position (inserted by the user if not retrieved by the location system of the device) the type of the violation and the author.

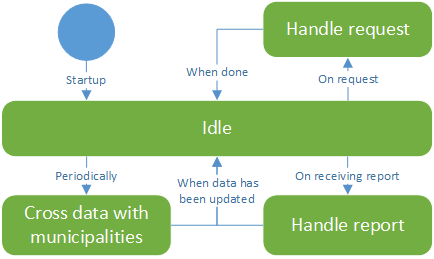
The next picture contains the class diagram representing the conceptual model of the application domain.



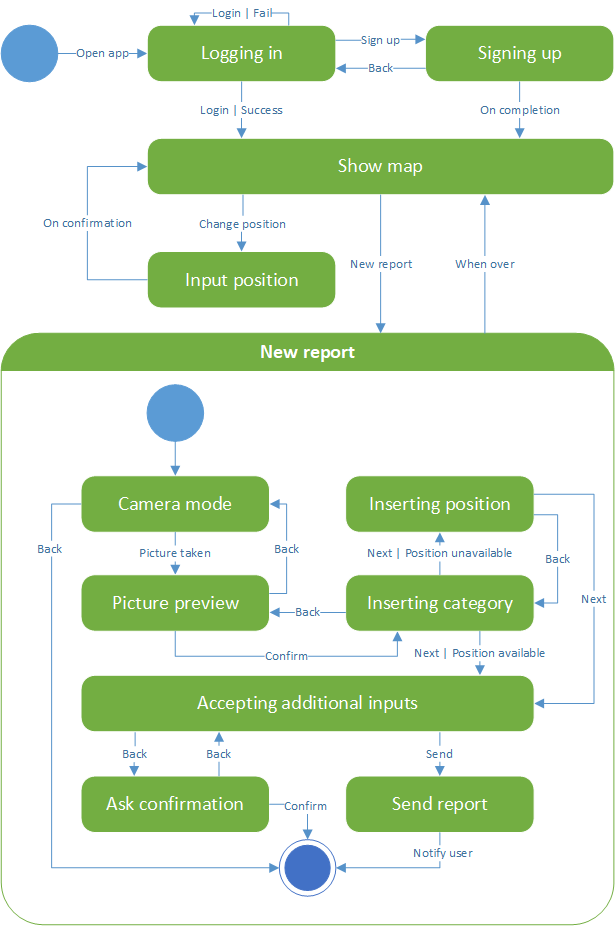
Here follows a state chart for the municipality app.



The next image represents the states of the server software.



The following picture shows the states and activities of the user app.



## Product functions

The requirements of the SafeStreet system are:

- R1: The reports about the violations are correctly stored.

- R2: The user can view the statistics calculated by the System except for the vehicles that have committed the highest number of violations.

- R3: The Municipality can access only the data of the violations of its competence area.

- R4: Violations registered by the Municipality can be retrieved by the system.

- R5: The system must avoid the manipulation of the violations.

- R6: The system must be able to retrieve the position from the user or from the GPS

- R7: Only the Municipality can access the submitted parking violation of its competence area

- R8: The system must allow to take a picture or select one from the device.

- R9: The system accepts reports from the User.

- R10: The System must calculate some statistics

- R10.A: The system must calculate the streets with the highest and the lowest number of violations.

- R10.B: The system must calculate the effectiveness of the service.

- R10.C: The system must calculate the vehicles that have committed the highest number of violations.

- R10.D:

- R11: The municipality can view all the statistics calculated by the system.

- R12: The System must suggest interventions to the Municipality.

- R12.A: Inspect an area

- R12.B: New cycle lane

- R12.C: New sidewalk

- R12.D: New pedestrian crossing

- R12.E: New parking

- R12.F: New speed detector

- R13: The System accepts only reports with a valid plate number and position.

The User can report only Parking violations. The User can select from this type of Parking violations:

* Parking on bike lanes
* Parking on reserved stall
* Double parking
* Parking on pedestrian crossing
* Parking on sidewalk
* Parking on traffic island
* Parking not payed
* Parking on red zone

SafeStreets can take from the Municipality also these types of violations. The Accidents are:

* Traffic light violations
* Incident between vehicles
* Speed violations
* Other violations

## User characteristics

### The user

The user is an individual who can send reports about traffic violations and access statistics, he must be registered and logged in to access the functionalities of the system. He will access the system mainly through a mobile device.

On registration, his identity is verified by a third party; he is accountable for the sent reports, and it is assumed that he will not send false reports.

### The municipality

The municipality is the authority that oversees the viability in the area and generates tickets. To use the system, it must be registered and logged in. The registration process for municipalities is not handled directly by the system.

## Assumptions, dependencies and constraints

The domain assumptions of the SafeStreet system are:

- D1: If the License Plate Recognizer recognise the license plate, then the result is correct.

- D2: If the map service recognises the street name from the coordinates, then the result is correct.

- D3: The Identity card is correctly verified.

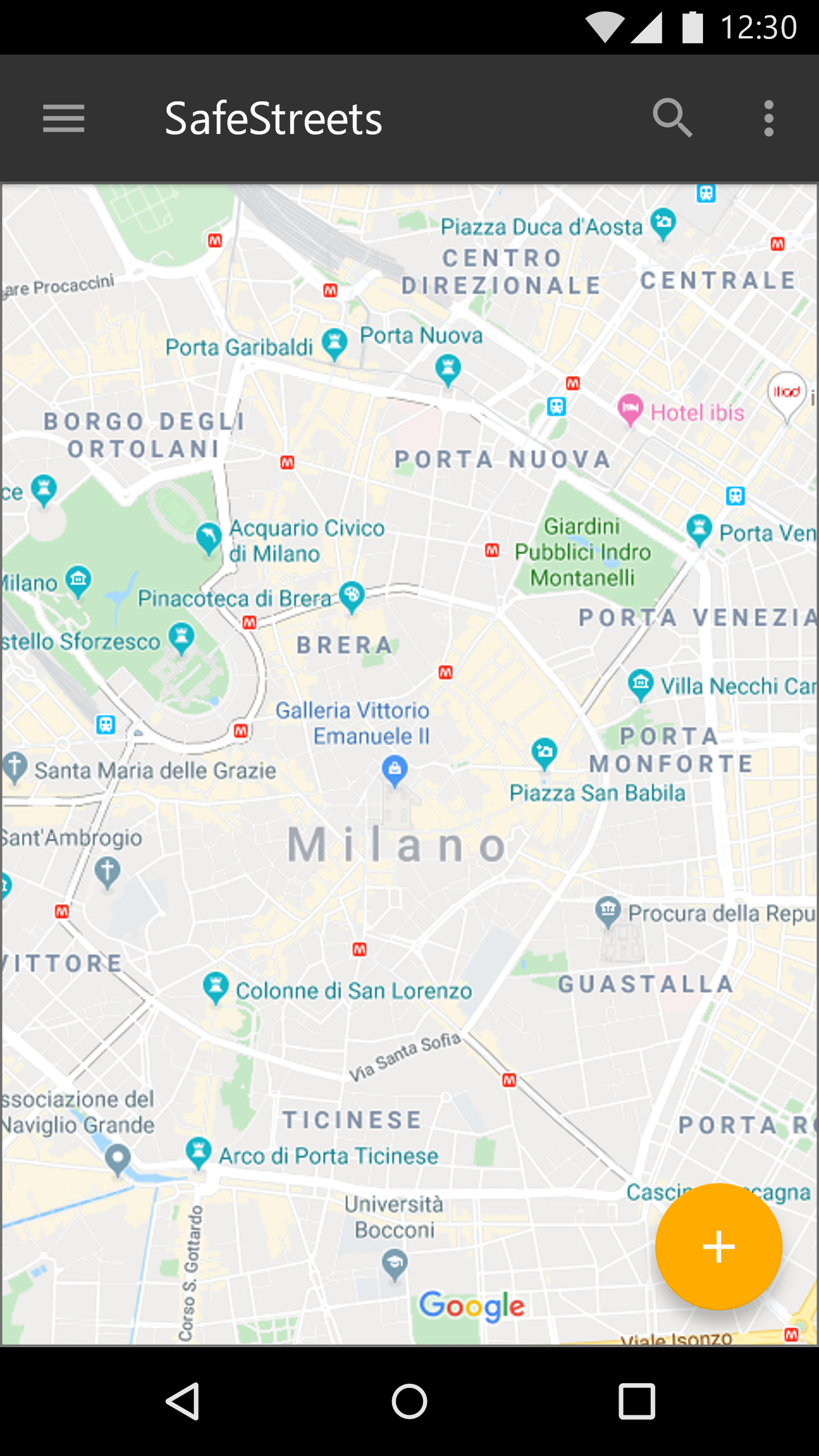
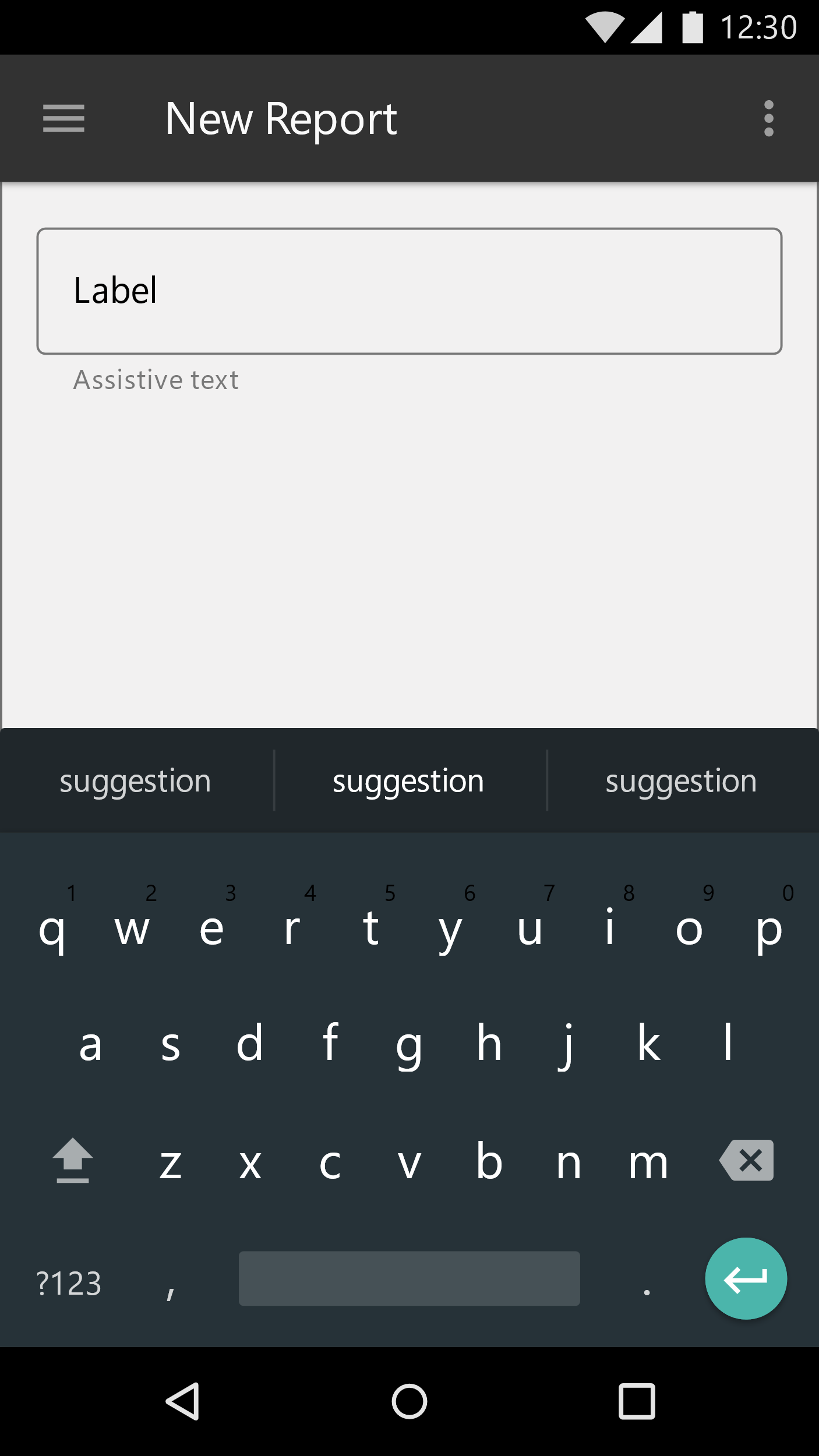
- D4: The Municipality possesses only real violations.

# Specific requirements

## External interface requirements

### User interfaces

The software will provide a different UI for the user and the municipality, providing different functionalities.

The above mock-ups are just an example of what the UI for the user might look like and shall not constitute a constraint on the final product.

### Hardware interfaces

The system does not directly access pieces of hardware; however, it will require for the user a mobile device with a camera and possibly GPS capabilities.

### Software interfaces

A maps service will be used to handle the maps in the user interface and to translate between coordinates and street names.  
An external service will be used to recognize the plate number in the submitted photos.  
The user identity verification is left to an external service.

The system will also need interfaces to handle the communication with the municipalities for the data integration, suggestions, and access reports services.

### Communication interfaces

The communication is done over the Internet, thus the devices used will need to be connected to the Internet.

## Functional requirements

### Use Case

**A close up of a map

Description automatically generated**

In all the following Use Case it’s implicit that in the Exception can also happens that the Connection can be lost during the flow of events. In this case what happens is that the System will discard the operation and if the User wants to do it again it has to return online, and the User must restart the whole operation.

The smartphone is considered as an actor because it allows to retrieve GPS coordinates and to take a picture

Here there are some **Scenarios**:

**ReportViolation**Bob is moving in the city and he discovers a traffic violation, so he wants to report this violation to SafeStreets. He downloads the SafeStreets’ App on his smartphone and he registers himself by providing the copy of his Identity Card and his generality. After the System has authenticated the User and it has verified Bob’s identity, Bob starts to fill the report of the violations (he has to take a photo with his smartphone, acquire the position, …) and when he has finished the report, he sends it to the SafeStreets’ System. When the SafeStreets System receives the report, it elaborates it: it sends the picture to the License Plate Recognizer, and it elaborates the position through the Maps Service, then if everything is all right it stores the notification. Otherwise if some errors occur, the System notifies Bob about the error and asks him to redo the operation.

**MunicipalityRegistration**The Municipality of Monza wants to increase his effectiveness in discovering new violation. The Monza’s Municipality also discover that the number of people that are using the SafeStreets’ App in the province is growing very fast. So, Monza’s Municipality decides to use the services of SafeStreets, so he contacts the SafeStreets’ Organization to elaborate a contract that gives to the Municipality a Contract Code. That Code must be prompted during the registration of the Municipality at the registration portal. The Monza’s Municipality sends the code to the System that verifies it and then ask to the Municipality the username and the password that will be used for the future login operations. The Municipality specifies his preference and it can access the violations reported to the SafeStreets’ System that are under its authority area.

**UserDataAnalysis**Alice is interested to find out how the local Municipality of Monza is working on the traffic regulation in her living road. Some Alice’s friends told her about the new possibility to use the SafeStreets’ App to analysis the violations of the province. She accesses with her account in the app and then she queries the System to find out the most frequent violations that had happened in his living road. The System, after receiving the request, evaluates if Alice can retrieve the requested data, and after it mines the information present in his Storage and, if the Monza’s Municipality is available, tries to retrieve the violations registered by the Municipality. The presentation of the result is sent to Alice, who can see on a map the result of his request.

**MunicipalityTicket**The Monza’s Municipality, after the registration, wants to access the violations, about his authority area, that has been reported to the SafeStreets System. In order to do so, the Municipality signs in the System and after he requests for a pull of the requested violations, the System then will check the request of the Municipality and he will send only the violations that are under the authority of the Municipality. The Municipality then retrieves the requested violations and he can check them and eventually it will emit a ticket. The Municipality also sends to SafeStreets the credential that can be used to access the information about the violations stored by them, if the Municipality offers this service.

**RetriveMunicipalityViolations**The Monza’s Municipality offers also the possibility of to retrieve the information about the violations that occurs on its territory and that has been registered by them. The SafeStreets uses the credentials provided by the Municipality to authenticate for the service. Then SafeStreets System can access this information when needed to provide the result of some data analysis, that come from the User or from the same Municipality.

**ElaborateReport**The System receives a report from Alice. The System then starts to elaborate the report. It first sends a message containing the report’s picture with the license plate of the vehicle committing the infraction that need to be recognized to the Plate Recognizer Service. After the response from the Plate Recognizer Service with the retrieved license Plate the System contacts also the Maps Service to retrieve the exact position of the violations. When the Masp Service responds with the request position coordination the System store the violations, and it informs Alice of the success of the operation.

**User Registration**

**Actors**: User, Identity Verifier.  
**Entry conditions**: The User wants to registrate himself in the system.  
**Flow of events**:

1. The Users sends the request of Registration
2. The Users starts to fill the registration forms
   1. A picture of the User is registered
   2. The User inserts his generality
   3. The User provides also his email, username and password he will use
   4. The User inserts the copy of his/her identity card
3. The user sends the form compiled and the system will take care of it
4. The system validates the user identity and verifies if another user already exists with the same generality
5. The system contacts the Identity Verifier in order to find out if the document provided by the User is valid.
6. When the Identity Verifies has correctly replied with the validated identity of the User, the System sends a notification to the User that the registration has been carried out correctly.

**Exit conditions:** The User has been correctly registered.  
**Exceptions:** Errors occurs if the Identity Document provided by the user cannot be validated by the Identity Verifier, or if there exists another User with the same generality, so the User receives an error message and he has to retry.

**User Login**

**Actors**: User  
**Entry conditions**: The User wants to access his account   
**Flow of events**:

1. The User fills the form with his generality and tries to sign in
2. The System receives this request and search the requested account
3. The System verify if the password is correct for the requested account
4. The System responds to the Client and give it the possibility of managing his account or to send some violations notifications

**Exit conditions:** The User has correctly sign in in his account  
**Exceptions:** If the User provide an email that doesn’t appears inside the User List, if the provided password is wrong, also if the User is already logged in, in all of this cases the User will receives an error messages and he has to retry the login with a different email or password.

**Report Compilation**

**Actors**: User, Smartphone  
**Entry conditions**: The User wants to notify a Violation   
**Flow of events**:

1. The User sign in the System
2. The User starts to fill a form for the Violations notification
3. The System asks the User for a picture of the violation with the license plate of the vehicle
   1. The User can now select to select a picture from the memory of his smartphone, or the User can take directly a photo from his camera
4. The User can select a picture from the gallery of make a shoot from his camera
5. The System receives the picture inserted by the User and ask the User to fill some required options
   1. The System asks the User to input the Position of the Violations
   2. The User can use the position retrieved through his smartphone or he can insert the position manually
   3. The System then ask the User to select the violation type
   4. The User insert the violation type
   5. Then the System ask the user to fill some options that are not mandatory
   6. The User responds with the non-mandatory options
6. The System than receives the Report and the Report will be elaborated

**Exit conditions:** The Report has been correctly received by the System  
**Exceptions:** The User cannot sign in the system, so the will receives an error message and he has to retry the login.

**Analysis Request**

**Actors**: User, Maps Service, Municipality  
**Entry conditions**: The User or the Municipality ask for an Analysis of the Data  
**Flow of events**:

1. The User or the Municipality sign in
2. The User or the Municipality ask for an analysis of the Data
3. The System receives the request and verifies if the User or the Municipality can access the requested Data
4. The System than retrieves the information from his knowledge and asks also the Municipality for their knowledge about the violations, if the Municipality of interests offers the service of retrieve the violations
5. The System from the retrieved data mines the information
6. The System elaborates a graphical representation of the data using the map provided by Maps Service
7. The System sends the result to the User or the Municipality
8. The result is displayed to the terminal of the User or of the Municipality

**Exit conditions:** The data correctly visualized by the User or the Municipality  
**Exceptions:** The System cannot understand the analysis request, the System cannot retrieve enough data for the Data Analysis, the System cannot access his knowledge of the violations or the knowledge of the Municipality, the system cannot interpreted the data that it has retrieved (for example Maps Service cannot understand the position), the User or the Municipality has the wrong right access for the requested data analysis, in all of this case the operation is aborted by the System and the User or the Municipality need to redo the request.

**Violations Request**

**Actors**: Municipality, Maps Service.  
**Entry conditions**: The Municipality wants to retrieve the violations notified to the System.  
**Flow of events**:

1. The Municipality sign in
2. The Municipality asks for an update of the latest notified violations to the System or it asks to retrieve some violations
3. The System elaborate the request and retrieve all the latest violations concerning the Municipality, and he verifies the right access to the violations
4. The System sends the latest violations to the Municipality
5. The Municipality access the update sends by the System

**Exit conditions:** The Municipality get the latest violations concerning its authority  
**Exceptions:** The Municipality cannot sign in; the municipality requests some violations that don’t concern the Municipality’s authority, in all of this case the System abort the operation and the Municipality will receives an error message, and the operation needs to be redo.

**Municipality Registration**

**Actors**: Municipality  
**Entry conditions**: The Municipality wants to perform a registration  
**Flow of events**:

1. The Municipality request a registration operation
2. The System asks the Municipality to insert his Contract Code
3. The System verify the contract code of the Municipality
4. The System asks the Municipality to select the credential for the next login operation
5. The Municipality sends the required credentials
6. The System memorize the credentials choose by the Municipality
7. The System ask the Municipality if they offer a service for retrieve the violations store by them
   1. If so, the Municipality sends the credential that the System can use to access this service
   2. Then the System verify the credentials provided by the Municipality
8. The Municipality is informed of the operation’s success

**Exit conditions:** The Municipality has been correctly registered and can access the services of the System  
**Exceptions:** The Municipality provides a wrong Contract Code, the Municipality provides wrong credentials to access their service (if the provides the service of access their stored violations), in all of this case the Municipality receives an error messages, and the operation needs to be redo.

**Report Elaboration**

**Actors**: System, Maps Service, License Plate Recognizer   
**Entry conditions**: The Municipality wants to perform a registration  
**Flow of events**:

1. The System starts the elaboration of a Report
2. The System sends the report’s picture with the plate of the vehicle committing the infraction to the License Plate Recognizer.
3. The License Plate Recognizer sends back the required plate to the System
4. The System ask to the Maps Service to provide the exact coordinate of the violation
5. The Maps Service sends back the coordinate to the System
6. The System then stores the violations

**Exit conditions:** The violation has been correctly stored.  
**Exceptions:** The License Plate Recognizer or the Maps Service are unavailable, this means that the System will try to contact them in future to validate the Report.

### Sequence Diagram

**Login**

**A close up of a map

Description automatically generated**This Sequence Diagram represents the Login operation: in this case the operation is carried out by the User but in the same way also the Municipality can access the SafeStreets’ System. After this operation, the User and the Municipality will be authenticated and they can use the services exposed by SafeStreets.

**Report**

**A screenshot of a social media post

Description automatically generated**This Sequence Diagram represents the sequence of operations carried out by the User to fill the form of a report. The Smartphone is represented as an actor because is used to collect the data about the User’s position and to take a picture about the violations. This operation can be performed after the Login operation that is presented above.  
Also the last respond message indicates that the SafeStreets’ System will take care of the elaboration of the report that is presented in the sequence diagram Elaboration below.

**Elaboration**  
A screenshot of a map

Description automatically generatedThis Sequence Diagram represents the sequence of operations that will be carried out by the SafeStreets’ System to elaborate the report delivered by the user. This sequence of operations happens after the User has correctly submitted the report, like In the Report sequence diagram presented above.

**Request Data Analysis**

**A close up of a map

Description automatically generated**This sequence diagram represents the sequence operations done to perform a data analysis request made by the User. As before this operation can be carried out if the user has been correctly logged in the system. This sequence of operations performed by the User, can be carried out also from the Municipality.

**Municipality Registration**

A screenshot of text

Description automatically generated

This sequence diagram represents the sequence of operations done to serve the Municipality Registration. After this the Municipality can correctly use the SafeStreets’ services.

**User Registration**

A screenshot of a map

Description automatically generated

In this sequence diagram are represented the operations done to perform the registration of a User. After this operation the User can log in the SafeStreets’ System.

### Mapping

In this section we indicate for each goal the requirements and the domain assumption to ensure the correlated goal:

* **G1: The System accepts reports by the users about the valid parking violations.**
  + R1: The reports about the violations are correctly stored.
  + R5: The system must avoid the manipulation of the violations.
  + R6: The system must be able to retrieve the position from the user or from the GPS
  + R8: The system must allow to take a picture or select one from the device.
  + R9: The system accepts reports from the User.
  + R13: The System accepts only reports with a valid plate number and position.
  + D1: If the License Plate Recognizer recognise the license plate, then the result is correct.
  + D2: If the map service recognises the street name from the coordinates, then the result is correct.
  + D3: The Identity card is correctly verified.
* **G2: The System suggests possible interventions to the Municipality.**
  + R1: The reports about the violations are correctly stored.
  + 56: The system must avoid the manipulation of the violations.
  + R10: The system must calculate the most unsafe areas.
  + R11: The municipality can view all the statistics calculated by the system.
* **G3: The System allows the Municipality to retrieve submitted parking violations.**
  + R1: The reports about the violations are correctly stored.
  + R3: The Municipality can access only the data of the violations of its competence area.
  + R5: The system must avoid the manipulation of the violations.
  + R7: Only the Municipality can access the violations.
* **G4: The System gives some statistics to the User about the violations.**
  + R1: The reports about the violations are correctly stored.
  + R2: The user can view the statistics calculated by the System except for the vehicles that have committed the highest number of violations.
  + R5: The system must avoid the manipulation of the violations.
  + R10: The System must calculate some statistics.
* **G5: The System gives all statistics to the Municipality about the violations.**
  + R1: The reports about the violations are correctly stored.
  + R5: The system must avoid the manipulation of the violations.
  + R10: The System must calculate some statistics.
  + R11: The municipality can view all the statistics calculated by the system.
* **G6: The System can retrieve the violations verified by the Municipality.** 
  + R4: Violations registered by the Municipality can be retrieved by the system.
  + R5: The system must avoid the manipulation of the violations.
  + D4: The Municipality possesses only real violations.

## Performance requirements

The software should be used without waiting times, apart from when the application is uploading the violations or when is downloading the statistics from the server, whose time depends on the internet connection.

## Design constraints

### Standard compliance

Since the data from the reports can be used by the municipality to generate traffic tickets, it is important that the chain of custody of the information is never broken. This means that the confidentiality and integrity of the data must be ensured both in its transmission and in its storage.

### Hardware limitations

The system for the user and the municipality will not need powerful devices to run, but will rely on an Internet connection, device camera, possibly GPS functionalities.

The system for the backend will need to cope with the volume of requests, thus will need to be powerful enough.

### Any other constraint

Apart from what already said on the chain of custody, the system will ensure different visibility levels for the user and the municipality, according to what already stated in this document.

## Software system attributes

### Reliability

Text

### Availability

Text

### Security

Text

### Maintainability

Text

### Portability

Text

# Formal analysis using ALLOY

Proof that the chain of custody is never altered.

# Effort spent

Text

# References

* Specification document: “Mandatory Project Assignment AY 2019-2020”

1. This is the Advanced Function 1 of the Project Assignment. [↑](#footnote-ref-1)
2. This is the Advanced Function 2 of the Project Assignment. [↑](#footnote-ref-2)