

SafeStreets project
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Requirement Analysis and Specification Document

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1 Introduction

1.1 Purpose

The purpose of this document is to provide a description of the SafeStreets system. A detailed explanation of the proposed solution is given, along with the requirements and assumptions made to achieve it.

SafeStreets is a crowd-sourced application that intends to provide users with the possibility to notify authorities when traffic violations occur, and in particular parking violations. With the amount of traffic we are seeing nowadays, it is hard to maintain order throughout the entire city, so the help of the community is more than welcome. The application allows users to report violations by sending pictures, along with important information, like the date, time and position. Examples of violations are vehicles parked in the middle of bike lanes or in places reserved for people with disabilities, double parking, and so on. The system also allows both end users and authorities to access the information gathered, with different levels of visibility depending on the roles. With the information provided, it is then possible for the municipality to integrate it with their traffic ticket system and automatically issue the corresponding ticket to a reported offender. This will accelerate the whole process, saving time and money to the state and could eventually result in a decrease in violations. At the same time, the ticketing system can provide information to SafeStreets, which presents the possibility of building statistics such as the most egregious offenders and analyse the effect of the application by looking at the trend in violations.

1.2 Scope

As already mentioned, the SafeStreets system is designed to provide users with the ability to report traffic violations through an application. In order to achieve this, the user needs to take and upload photos of the scene, which captures the license plate of the vehicle committing the violation and complete a form with information such as the license plate number and the type of violation. This data, along with metadata retrieved from the user's device (geographical position, date and time) is then sent to the system.

1.2.1 Goals

- G1 - The user is able to report a traffic violation to authorities.
- G2 - License plates can be recognized from the pictures of the violation report.
- G3 - Roles with different levels of permission are assigned to users and authorities.
- G4 - The information gathered from the reports is provided to users and authorities according to their role.
- G5 - The system must protect the chain of custody of the reports.
- G6 - Reports that had their integrity compromised and malicious reports will be detected and discarded.
- G7 - Information about issued tickets provided by the municipality system can be cross referenced with the SafeStreets database and analysed.

1.2.2 Definitions, Acronyms, Abbreviations

1.2.3 Revision history

1.2.4 Reference documents

1.2.5 Document structure

2 Overall Description

2.1 Product perspective

As for the SafeStreets system, the domain model is described in the diagram shown in Figure 1. Note that the diagram is not a complete description of the system, but rather a simplified version for easier understanding.

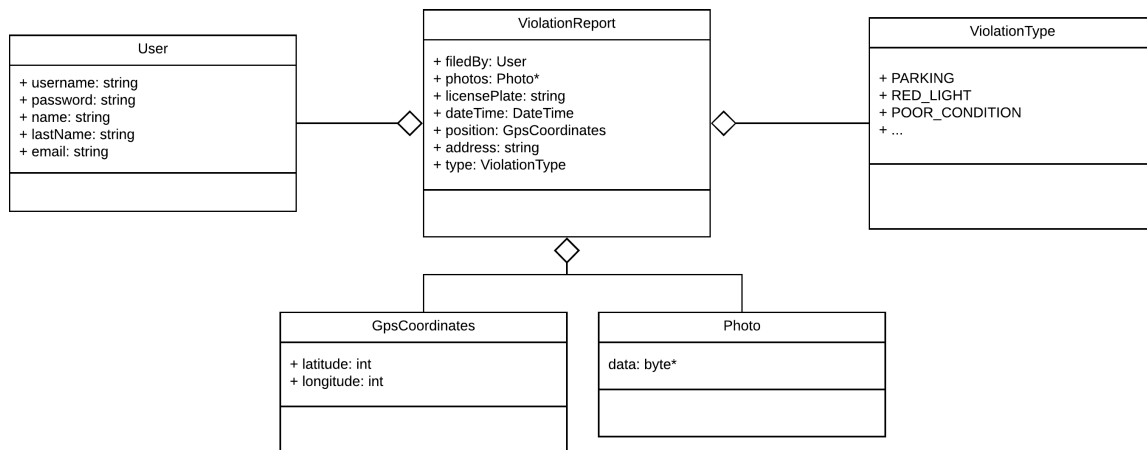


Figure 1: Class diagram.

Inspecting the class diagram, we can see that most of the system revolves around the violation reports and their processing, this is the core of the system. In the state diagram shown in Figure 2, the process of submitting a report is explained.

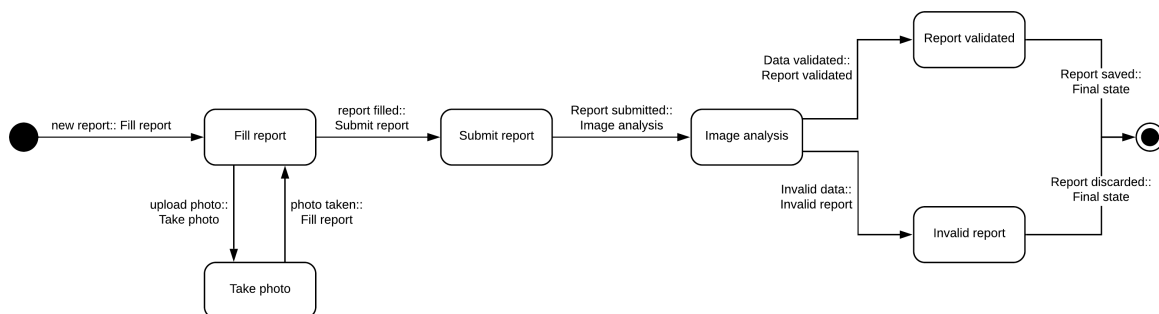


Figure 2: State diagram - Report submission.

As observed in the diagram, for submitting a report, the user is first required to fill a formulary with the required information and photo. After the submission, the SafeStreets system executes an analysis of the data, matching it with the provided image. This can result in either a invalid or a valid report. An invalid report is discarded, with possible measures taken against the account that submitted it. A valid report is saved in the database. When the report is saved, it is made available for the different users to query, either through the mobile application or through the public API.

2.2 Product functions

The functionality of the system can be divided into three groups. In the following section, these functions are listed and explained, taking into account the already specified goals of the system.

2.2.1 Violation report

The reporting of violations is the main functionality of the system. It allows its registered users to submit a traffic violation report. The user is required to provide data, such as a picture of the violation, the license plate of the vehicle committing the violation and the type of violation. On top of this information, the mobile application will provide the system with metadata which includes the gps location, date and time of the report. After the submission, the system analyses the provided information, checking its integrity. If the report is considered invalid or to have been compromised, it is discarded and the user is flagged as not trustworthy. Otherwise, the report is saved and made available to the rest of the system.

2.2.2 Image analysis

In order to confirm the validity of a report, the system performs an analysis of the submitted image. The picture is expected to show the vehicle committing the violation along with a clear view of its license plate. The analysis searches the image for this information and matches the detected license plate with the one provided in the report.

2.2.3 Data querying

Gathered information by SafeStreets can be accessed by all users. There are two ways in which the data can be accessed, via the mobile application or through the public API. In the first case, the mobile application provides users with the ability to see violations in a map, allowing the user to also filter these violations by date and type. On the other hand, the API allows for SafeStreets to be integrated with other third party systems. Users are able to query the available data according to their role and obtain the information in an analysis-friendly format.

2.3 User characteristics

The actors identified as the users of the application are:

- User: A person that has registered to SafeStreets and is capable of reporting violations.
- Municipality system: A system belonging to the municipality that communicates with SafeStreets through the exposed API. Capable of accessing more information than the standard user.
- Administrator: An employee of SafeStreets that maintains and updates the system.

2.4 Assumptions, dependencies and constraints

- D1 - An accurate gps location can be acquired from the device the user is running SafeStreets on.
- D2 - The device running SafeStreets has a camera.
- D3 - A violation report cannot be canceled
- D4 - The metadata of the picture in the violation report is accurate
- D5 - There is a system available capable of connecting a license plate to characteristics of the car (make, model, color)

3 Specific Requirements

3.1 External interface requirements

3.1.1 User interfaces

3.1.2 Hardware interfaces

3.1.3 Software interfaces

- License plate recognition: it is necessary to be able to recognize the license plate in the picture a report. For this, a good option is OpenALPR, an open source library that can be run server-side (due to performance limitations). A cloud API is also provided, which could be used during early stages of development.

3.1.4 Communication interfaces

3.2 Scenarios

3.2.1 Scenario 1

John has a spot on his street reserved for his garage entrance. During the week, he commutes to work by subway, and leaves the car to his wife, Sarah, who leaves later in the day. It is not unusual for him to find someone blocking the garage when he goes to work in the morning. If the car is still there by the time Sarah needs to leave, she will be late to the office. Before using SafeStreets, he would have to call the police and provide a license plate and address, all while hurrying on his way to work. Now, he can just take a picture and then submit a report while he is sitting on the subway.

3.2.2 Scenario 2

Marco is a data science student at Politecnico di Milano. As he bikes every day to the university, he is familiar with the problem of cars parking in the bike lane. Thanks to the SafeStreets API, he can easily obtain data about it using Python. So, he decides to base his thesis on this topic and analyzes the patterns in violations throughout all of Italy, comparing different cities and their countermeasures.

3.2.3 Scenario 3

Chad's girlfriend broke up with him last week because he was too jealous and would not let her go out with her friends. He is not over this and is really mad at her. All of the sudden he gets a brilliant idea, he takes a picture of the license plate of the girls car and prints it. Then, a couple days later he finds a double parked car, attaches the printed license plate to it and reports the incident with SafeStreets. The system detects that something is wrong with the picture, so it decides not to save the report and marks Chad's account with potential misuse of the application.

3.2.4 Scenario 4

Sally wants to go to the city centre to buy some groceries, but she is not sure if she should take the car or go by bus. She grabs her phone, boots up SafeStreets and checks the vicinity to the supermarket. The app shows a high concentration of badly parked cars, she assumes that there is a lot of traffic and nowhere to park her car properly, so she decides to take the bus.

3.3 Functional requirements

- G1 - The user is able to report a traffic violation to authorities

- D1 - An accurate gps location can be acquired from the device the user is running SafeStreets on.
- D2 - The device running SafeStreets has a camera.
- D4 - The metadata of the picture in the violation report is accurate
- R1 - The user must be able to fill out a form providing information about a traffic violation.

G2 - License plates can be recognized from the pictures of the violation report

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G3 - Roles with different levels of permission are assigned to users and authorities.

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G4 - The information gathered from the reports is provided to users and authorities according to their role.

-

G5 - The system must protect the chain of custody of the reports

- RX - The system must provide e2e encryption from the device of the user to the server.

G6 - Reports that had their integrity compromised and malicious reports will be detected and discarded.

- D5 - There is a system available capable of connecting a license plate to characteristics of the car (make, model, color).
- RX - SafeStreets must cross reference the information of the car registered under the detected license plate with the information obtained from analyzing the report picture.

G7 - Information about issued tickets provided by the municipality system can be cross referenced with the SafeStreets database and analysed

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3.3.1 Use cases

Name	Sign up
Actor	User
Entry condition	The user has installed the application on their device. The application is running.
Event flow	1. The user presses the “Sign up” button. 2. The user fills the fields with the required data. 3. The user presses the “Confirm” button. 4. The system saves the data.
Exit condition	The user is successfully registered in the system. The user is redirected to the login screen.
Exceptions	- The user is already registered in the system. The system warns the user that the email is already in use. - The user did not fill all the required fields. The system marks the empty fields for the user to fill. - The password does not meet the security requirements. The system asks the user to enter another password.

Name	Sign in
Actor	User
Entry condition	The application is running. The user is signed up.
Event flow	1. The user presses the “Sign in” button. 2. The user fills the “Username” and “Password” fields. 3. The user presses the “Sign in” button. 4. The system verifies the user credentials.
Exit condition	- The user is successfully signed into the system. - The user is redirected to the home screen.
Exceptions	- The user enters a non matching combination of “username” and “password”. The system shows a warning that “username” and “password” do not match. - The user did not fill all the required fields. The system marks the empty fields for the user to fill.

Name	Submit report
Actor	User
Entry condition	The application is running. The user is signed up. The user is in the home screen.
Event flow	1. The user presses the “Submit report” button. 2. The user fills the fields with the required data. 3. The user presses the “Take photo” button. 4. The user takes a photo of the vehicle committing the violation. 5. The user presses the “Confirm” button 6. The system submits the report
Exit condition	- The report is successfully submitted.
Exceptions	- The user did not fill all the required fields. The system marks the empty fields for the user to fill. - The user did not take a photo. The system warns the user to take a photo

Name	See reports map
Actor	User
Entry condition	The application is running. The user is signed up. The user is in the home screen.
Event flow	1. The user presses the “Reports map” button. 2. The user fills the “from”, “to” and “type” fields. 3. The user presses the “filter” button. 4. The system shows an interactable map with reports that match the filter.
Exit condition	- The system shows the reports map.
Exceptions	- No reports matching the filter were found. The system shows the empty map.

3.4 Performance requirements

3.5 Design constraints

3.5.1 Standards compliance

3.5.2 Hardware limitations

3.6 Software system attributes

3.6.1 Reliability

3.6.2 Availability

3.6.3 Security

3.6.4 Maintainability

3.6.5 Portability

4 Formal Analysis Using Alloy

Organize this section according to the rules defined in the project description.

5 Effort Spent

Provide here information about how much effort each group member spent in working at this document. We would appreciate details here.

References