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REQUIREMENTS ANALYSIS AND SPECIFICATIONS DOCUMENT

SOFTWARE ENGINEERING II PROJECT - A.Y. 2019-2020

SafeStreets

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1 Introduction

1.1 Purpose

The main purpose of SafeStreets is to create a software that provides users the possibility to notify authorities when parking violations occur providing some useful features such as finding the most unsafe areas around them and proposing suggestions to the municipality. In addition, SafeStreets will enable the Local Police to generate traffic tickets from it and to cross all the information it owns with the data of the accidents happened.

Specifically, we want to realize a product which is able to:

- Retrieve pictures uploaded by users of parking violations with possible attached information such as license plate position in the image, type of violation and GPS meta-data.
- Automatically complete the data of a reported violation running a recognition algorithm able to read license plate text.
- Highlight to users the areas with the highest frequency of violations and information about vehicles that commit most violations.
- Automatically identify potentially unsafe areas crossing SafeStreets' information with accident datas from the Local Police, possibly suggesting possible interventions.
- Send violations data to the Local Police to automatically create new traffic tickets if it can be proved that the chain of custody of the information coming from the users is never broken.
- Generate statistics related to ticket emissions to inform users about how effective SafeStreets is.

On the other hand, the purpose of this paper is to define in a detailed way all the functions and requirements of the application.

In doing this, we start focusing on a brief overview to characterize the product with relevance to its interaction with the world, then we will proceed deeply in analysing which functions are relevant and should be provided, and which requirements are needed to the stakeholders.

1.2 Scope

As our software needs to be compliant with different laws and as it needs to interact with the Local Police, initially, SafeStreets will have a restricted geographic domain coincident with the Italian city of Milan.

Indeed, in order to provide the most complete service, SafeStreets will require the access the Local Police web application to be able to process traffic tickets.

It goes without saying that to organize this kind of service in the most effective way we must experiment first this activity in a internationally-visible city, then applying that to anyone who will demand.

1.2.1 The world-machine phenomena

The first model of our system to be presented is the model "The world and the machine" by M. Jackson and P. Zave. This model highlights the division between phenomena that happen entirely either in the world or in the machine, and those that are shared between the two of them.

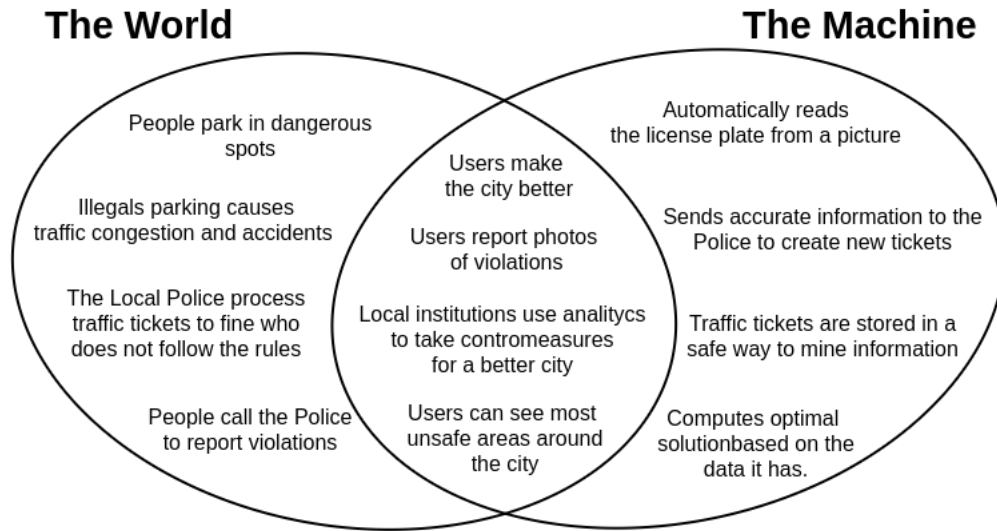


Figure 1: The world-machine phenomena chart.

1.3 Goals

- [G1] Notifying authorities when particular parking violations occur.
- [G2] Permitting both users and authorities to learn which areas have the highest frequency of violations.
- [G3] Permitting both end users and authorities to learn which vehicles commit the most violations.
- [G4] Suggesting possible interventions to potentially unsafe areas.
- [G5] Allowing the local police to generate traffic tickets from SafeStreets data.
- [G6] Building and exhibiting statistics.

1.3.1 Traceability Matrix

Since goals, functions and constraints are related to each other a traceability matrix is provided in order to enlight the various relationships among them.

Goal ID	Functions ID	Constraints ID	UseCases ID	Other references
G1	-	C1, C2, C5	-	-
G2	-	C3	-	-
G3	-	C4	-	-
G4	-	C1	-	-
G5	-	C5	-	-
G6	-	C2	-	-

Table 1: Traceability Matrix

1.4 Definition and Acronyms

1.4.1 Definitions

1.4.2 Acronyms

1.5 Revision

1.6 Actors

- *Guest*: This actor plays the role of a person who is not registered and thus logged in.
- *User*: This actor refers to the condition of a normal person (not an officer) already signed up and logged.
- *Officer*: This actor represent a signed up and logged in public officer.

1.7 References

- The 2019-2020 Software Engineering 2 Project Assignment document
- The IEEE Standard for RASD

1.8 Document Structure

This document is divided in four parts:

- **Introduction**: a description about the goals of SafeStreets and the context in which it will be implemented is provided. Subsections dedicated to the understaing of some acronyms and definitions are also present.
- **Overall Description**: gives an overall description of SafeStreets, focusing on the domain assumptions and the constraints of the application. This section also aims to provide a context to the whole project and to show its integration with the real world. It also shows the possible interactions between the world and the users of SafeStreets.
- **Specific Requirements**: the software requirements, explained in a sufficiently detailed manner to design a system that satisfy them, and the testers to test said requirements are provided. It is also present a

detailed description of the possible interactions that can occur between the world and the system, followed with a series of simulations and previews about the above mentioned interactions.

- **Formal Analysis using Alloy:** the requirements are expressed through the Alloy model, with which is possible, since it is a declarative specification language, to define the functions, the constraints and the interactions of SafeStreets.

In the last part of the document a short note that summarize the effort spent in producing this RASD by its authors is shown.

2 Overall description

2.1 Product perspective

The idea is to create an application to allow users to report parking violations without taking much time to their daily life. According to this intention, we would like to realize an extremely friendly user interface and a lightweight software in order to make SafeStreets affordable to many people as possible and runnable by many devices.

Users will certainly be able to exploit the advanced functions of SafeStreets such as charts and analytics, but as those functions rely over data, the basic violations reporting function will be the core one.

Since a small downtime of SafeStreets is not going to cause damage to anyone, it will be tolerated without much thoughts. On the other hand, as our software is going to run some kind of OCR and AI recognition algorithm that will probably be expensive in terms of resources, it should be very dynamic to support different queries in a few seconds.

In addition, our software is going to process very specific data that could potentially lead someone to be fined, hence it should ensure that the chain of custody is never broken and the images are never altered.

To upload a new picture on SafeStreets or to view charts about violations, it is obviously required an active and functional internet connection. But as said, as data are the core business of SafeStreets, there will be put in place a mechanism such that a user can insert all the information needed to report someone on his mobile application, then those information will be sent as soon as the internet connection is restored.

Concerning the hardware, we intend to have a database which contains all the historical information about reports made by the people. This database will allow both users and officers to see both aggregated and detailed information that require an huge amount of data to be processed. Hence, the internal database engineering should take this into consideration.

2.2 Product functionalities

This section provides an abstract of the main functions of the application. To be able to use any of the given functionalities, the user must first register and then login to the application by providing a valid email and a password.

2.2.1 Notification of Violations

The base function of the application is the possibility to signal a traffic violation.

The user must send one or more picture(s) of the car in which both the violation and the license plate are clearly visible.

The application will try to automatically get the user position using its GPS system, and will notify the user in case of failure so that it can enter it manually.

The users will then send the following information to the system:

- The pictures selected by the user
- The position of the user
- The current date and time
- The type of violation (to be picked from a pre-defined list)
- An optional comment inserted by the user

The information sent by the user will be stored on persistent storage on the server and the police will be able to see it on their clients.

2.2.2 Data Mining

The system will allow the users to extract statistics about violations in the various areas/streets of the cities in the system, for example a user can find the areas in which most segnalations occurred in the last 3 months.

Data mining must take into account the privacy of the users. To guarantee an acceptable level of privacy, different roles are given to the users and the officers.

In particular, a user will only be able to see statistics provided by aggregated data, never he will see the absolute numbers but only percentages.

Officers, instead, will have the finest granularity: they will see all the information enriched by the actual number of violations and can drill down to the specific licence plates which committed the violations. They will also have more filters available with respect to the users, for example the possibility to see which cars committed most violations in a given period.

2.2.3 Request for interventions

The system will get information from the local police systems about incidents, including the location, the licence plates of the cars involved, and the infractions committed.

By crossing the data about the incidents with the segnalations from its users, it will be able to find unsafe areas and also to suppose a reason for it and make suggestions. For example, if a road has many cyclists hit and many signals of cars parked on the bike lane, it can suggest to add a barrier between the parking lane and the road. The correlations between the infractions found on the police system and the ones on the SafeStreet system, along with the possible solutions, must be done by hand by some human parties. An artificial intelligence can then help to calibrate when the system should launch a warning, training on the approval/rejection of the previous signals.

The officers responsible for handling these recommendations will see on their clients all the data about the signal, including the number of incidents and signals, and can decide to discard it or approve it, thus keeping it in the system for future reference. All the approved signals will be reachable by the officers, once they have been resolved they can be deleted from the list but will remain in an archive available for the AI.

2.2.4 Automatic Tickets

The user will be able to give tickets when he spots a violation. This works by adding to the functionality "Notification of Violations" the possibility to confirm that he is sure that he is signalling an actual violation and wants to give a ticket. In this case the system reads the licence plate and uses the police system to automatically issue a ticket.

Security is a key aspect of this functionality. The system must be sure that the signal was sent by the user and that it has not been modified. To achieve this, the user must insert a passcode every time he wants to issue a ticket to confirm that he is the actual owner of the account. Also, all

messages are encrypted with TLS and an hash of every picture is included in the message to make sure that it has not been modified.

The system will also be able to build statistics using the ticket system. These data will represent the amount of tickets given in a certain street/area in a given period, the most egregious offenders, and the change in the number of tickets in a certain place during time. Just like in the Data Mining section, users will not be able to obtain information on single people, they will only see aggregated data and percentages instead of total numbers. The officers will instead have the possibility to see the actual numbers and to get information about specific license plates.

2.3 User characteristics

The users of SafeStreets can be both males or females of any age with no particular limitations. Of course, said users should have at least basic knowledge of smartphones and electronic devices in general, especially on how to make photos and videos. Users should also have an e-mail address, primarily used to register and authenticate themselves.

Authorities instead can also be both males or females but they need to be actual public officers. They should have a medium knowledge of networks, softwares and hardwares as well as a fully understanding of how traffic tickets laws can be applied, and they should be capable of using municipality tools and softwares fluently.

2.4 Assumptions and dependencies

2.4.1 Domain Assumptions

- A user should input only correct data when reporting a violation, for example the license plate position should be correct
- The image and picture meta-data aren't altered by the user who first submit the report
- The municipality will provide provide correct and complete information about the accidents
- The municipality services are supposed to be functional during the uptime of SafeStreets.

2.4.2 General Assumptions

- A user cannot access any of the functionality of the application if he does not register first. Since security in the application is a fundamental part and users must be accountable for their signals, the registration approach will be the one used by car sharing services: the user will provide an email, a password, an identity document and a selfie of himself holding such document in which his face is clearly visible. Also, he will provide a 4-digits code that he will have to use every time he chooses to send a ticket, even if he is already logged in. All these data will be approved by hand by an operator during the registration phase.
- Since users are personally accountable for what they do with the app, we suppose that they will use it in the most responsible way. For this reason, all tickets that are inserted correctly will be automatically approved.

2.4.3 Constraints

- [C1] It is impossible to send a report without attaching a picture, a description or selecting any reason.
- [C2] It is impossible cancel an already sent ticket.
- [C3] It is impossible to attach a non-valid address to a picture.
- [C4] Is prevented to send a report with a picture that contains non-readable license plate.
- [C5] The chain of custody of the information coming from the users shouldn't be broken.

3 Specific requirements

3.1 External Interface Requirements

3.1.1 User Interfaces

3.1.2 Software Interfaces

Considering the domain of our application, we decided to integrate in our project some software components to create an easier-to-use product.

In order to provide users the ability to automatically insert location info into their violation pictures meta-data, we chose to adopt a location provider service. That supplier should expose an API to retrieve the user exact address by his or her GPS position coordinates.

In addition, APIs provided by the municipality are required to retrieve real time information about the accidents that occurred on the territory of the municipality to allow information mining and suggestion proposing.

Finally, the Local Police is required to provide an API to retrieve information about violation coming from SafeStreets users to create and process traffic ticket from it.

3.2 Non functional requirements

3.3 Scenarios