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Software Engineering 2 Project:

"SAFE-STREET"

Requirements **A**nalysis and **S**pecification **D**ocument

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1 Introduction

1.1 Purpose

1.1.1 General Purpose

Nowadays, an ever-increasing number of cars and a shortage in the number of police officers caused the emergence of various traffic violations and accidents. Although two traditional solutions to solve these problems were rising the number of police officers and their equipment, due to the poor efficiency and inordinate cost, it is not feasible to continue this trend. This is where the power of technology can take the responsibility to help authorities to bring the order to the streets.

The only solution to assist authorities without expanding budgets is to participate in people with an intuitive and simple method. Hence, the *SafeStreets* app is proposed, which provides the possibility of reporting traffic violations and accidents by taking advantage of crowed-sourcing. Users can report violations by just taking pictures of infringement and license plate, then sending them.

1.1.2 Goals

The goals that the system aimed to achieve are presented as follows:

- [G-1] Users should be able to report traffic violations
- [G-2] Users should be able to access information regarding the safety of different areas.
- [G-3] Authorities should have access to the details of the traffic violations reported by the users.
- [G-4] Authorities should be provided with possible interventions to prevent violations.
- [G-5] Authorities should have access to refined data related to committed violations.
- [G-6] Users should be able to view reports that they have previously made.

1.2 Scope

The *SafeStreets* system shall be providing four main functions to various users; in this section, the system boundaries and scope used to define the limitations and different responsibilities of the S2B.

The first of the main functionalities is the enabling of users to report traffic violations. Regarding this, some phenomena are regarded as world phenomena not viewed by the system due to its limitations such as the fact that the system does not directly detect a violation. However, it can be accounted for by the system through a traffic report made by the users. Moreover, another functionality that has to do with the users is the publishing of collected data to be viewed by the users in a refined representation to help them consider the safety of various areas based on traffic violations. The data is also communicated to the authorities but with different levels of details.

The other two main functions have to do with the *SafeStreets* system providing services to government authorities. The domain limitations of the system affecting this interaction are also discussed in this section. Such as, the fact that the system is only able to make suggestions for preventive measures to the authorities based on the accident data that have been communicated. Meaning, that the system does not have any knowledge of accidents unless they are reported by the authorities and that the system can only suggest interventions and neither put them into place nor can detect them being applied. Moreover, a second function to the authorities would be the communication of traffic reports received from users to be later used by government officials to give out traffic tickets, the system responsibilities to support this process is to prevent the users from tampering with images *digitally* and to provide the collected reports to the authorities proactively. In other words, physical tampering with license plates to mislead authorities and the actual process of giving out tickets is not part of the application domain.

Below is a table summarizing and classifying the different phenomena that are related to the system functionalities. Main system functionalities: F1: Reporting of violations F2: Communication of collected data to users F3: Suggestion of interventions F4: Communication of reports for ticketing

Phenomena	Classification	Justification	Functionality
Tampering with license plate	World	Pure world phenomena since no measures are to be applied to detect nor prevent this phenomenon therefore it is unobserved by the system	F1, F4
Issuing of tickets	World	The actual issuing of the tickets is the responsibility of the authorities the system has no part in it and does not have access to the data regarding issued tickets	F4
Putting preventive measures for traffic violations into place	World	The application of preventive measure by the municipality is also a pure world phenomenon as the system has no means of knowing new measures by applied	F3
Traffic violations	World	The system does not directly observe or detect committed traffic violations if they are not reported by the user then the system cannot be held responsible for not having knowledge of them	F1, F4
Occurrence of accidents	World	Similarly, to traffic violations unless system acquires this kind of data through the authorities it has no way of detecting such phenomena	F3
Publishing of insights regarding the accumulated data	Shared	Performed by the machine observed by users and authorities in the world world	F2
Reporting traffic violation	Shared	Performed by users in the world observed by the machine	F1, F4
Publishing of accident data by the municipality	Shared	Performed by authorities in the world observed by the machine	F4
Suggesting interventions	Shared	Performed by system and communicated to authorities then if applied observed by the world	F3

Table 1: World and machine phenomenas.

1.3 Definitions,Acronyms,Abbreviations

1.4 Revision history

1.5 Reference Documents

References

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[2] alloy maker. *Alloy Documentation*. blah publisher, ISBN, 1905.

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`https:google.com`

erfan [2]

1.6 Document Structure

The requirement analysis and specification document(RASD) is consisting of five chapters, an outline is presented as follows:

Chapter 1 is an introduction, which states the problems of traffic violations and also describes the previous unsuccessful methods that did not have tangible results. In addition to that, it illustrates the goals that the system aimed to reach and defines the scope of the system by pointing the world and shared phenomena.

Chapter 2 is about the perspective of the product along with details in actors, shared phenomena, assumptions, dependencies and constraints. On top of these for more elaboration class and state diagrams are used to demonstrate the general view of entities and behaviors of actors, respectively.

Chapter 3 contains information on interface requirements in terms of software, hardware and communication between them. Furthermore, user system interactions are represented in detail through use case diagram, sequence diagram and scenarios. Moreover, most significantly functional requirements with associated domain assumptions are declared, followed by design constraints and system attributes.

In chapter 4, Alloy which is a declarative specification language used to model behaviors and analyze various parts of the system.

Chapter 5 indicates the effort spent on each part of the document for each group member.

2 Overall Description

2.1 Product perspective

The *SafeStreets* system can be viewed as a standalone system in the sense that it does not depend on other external systems in order to properly function. However, in order to provide some external services to other entities it requires the provision communication interfaces to facilitate the flow data to and from the system. To be more specific, to interact with the municipality it is needed to have the appropriate interfaces as channels to retrieve data to be processed and to provide processed and aggregated data.

Apart from the aforementioned system interaction, *Safastreets* seldom depends on external services or systems. This is specially true for the main features of the system; i.e., the services provided to the civilian users. Specifically, the service provided in order for users to report traffic violations and the *View Safety* feature which could be seen to built upon the first feature; since, it is considered as a geographically oriented representation of report data.

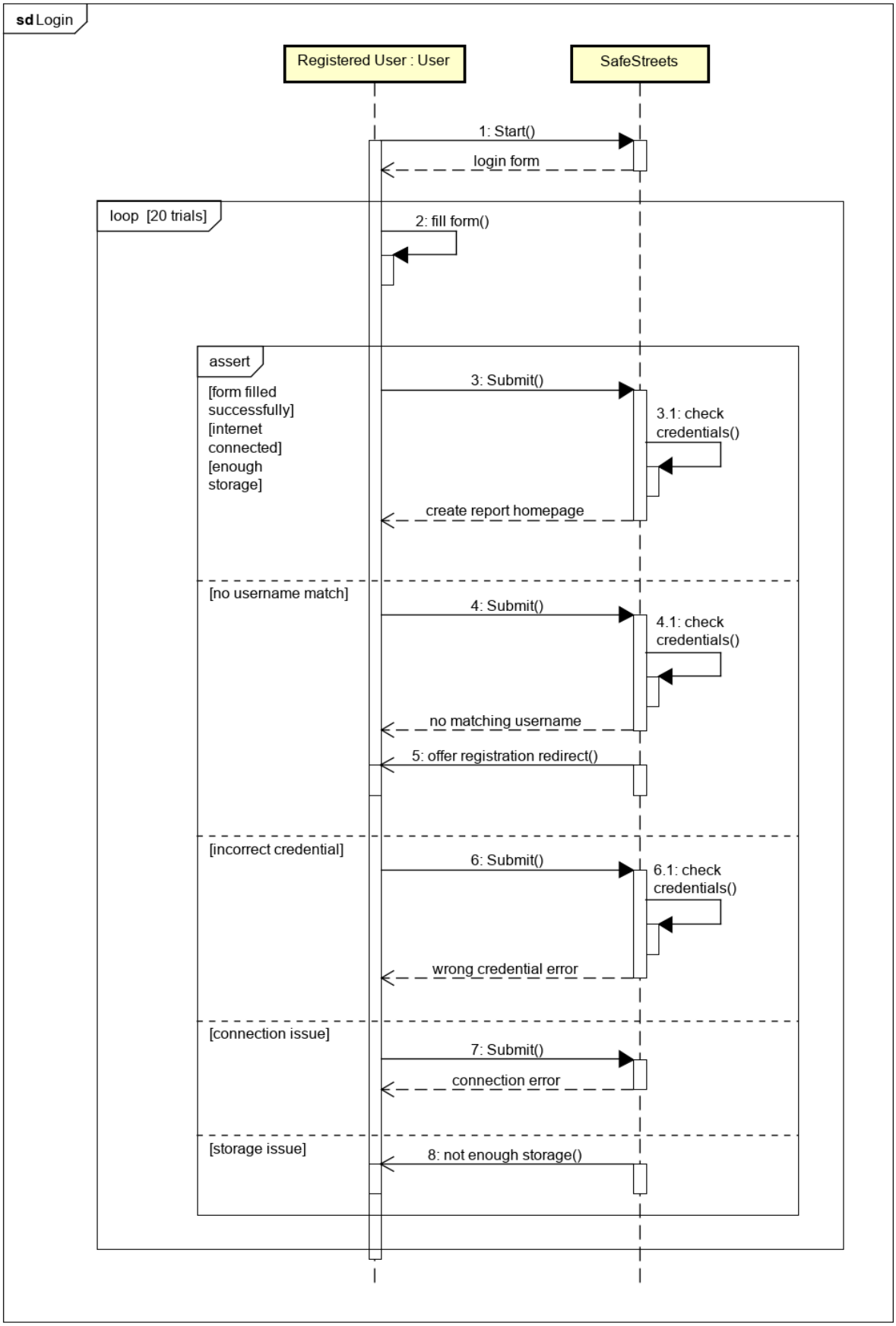
Surely, the internal modules of the system are codependent since the data collected from user and possibly retrieved from the authorities flows internally through the system in many forms such as raw report details, insights built on report details and graphical representations. *Figure 1* provides a high level representation of the entities interacting with the system and represents the relationship between abstract entities, such as, *Report* and *Safety Representation*.

place holder for entity class diagram

Furthermore, since the users are viewed as the main entity interacting with the *Safestreets* system it is rather important to clearly define the different states of the user and the state defining interactions with the system. First and foremost, it is worthy of mention that all user-system interactions are done through the user interfaces to be presented in the following sections. Moving onto the relevant topic of user states as seen by the system, any user can be classified into one of three categories; this classification is based on the different features accessible to the user. First, is the *unregistered users* who are unable to access any of the system features until registration; which brings us to the second category of user, the registered users which are able to access all system features apart from creating traffic reports; atleast, not until they allow the system to access their mobile phone camera and location services. Finally, fully activated users who have are able to fully exploit the *SafeStreets* features.

The following state diagrams show a clear representation of the different user states and the user actions that cause a transition from one classification to another. As well as, a representation of the permission granting process that is a sort of a prerequisite for becoming an activated user.

Figure 1: Sequence diagram for Login



2.2 Product functions

In the following subsection the various major functions of the *SafeStreets* system; which were briefly mentioned in the *Scope* section of the document. However, this section shall provide a more in depth description of said functions providing a broad yet clear overview of the system's functionality.

2.3 Violation Report

The *Violation Report* function is the motivating main function of the *SafeStreets* system. This function provided mainly to be used by the average or in other words civilian user entails the enabling of such users to formalize traffic violation reports and submit them to be later used by either the system internally or by an external benefactor; i.e., the municipality. The described functionality is achieved through a user interface; ideally, a mobile phone through which the accesses the *SafeStreets* interface and starts the process of reporting a violation. This process is briefly constituted by the imaging of the violation directly from the interface, the verification of the detected plate number and detected location and filling in some data regarding the details of the traffic violation, e.g., the violation type. Finally, the user submits to report which is saved and used by multiple other functions as will be discussed in the coming sections.

2.4 View Area Safety

This second function is also mainly used by civilians; although, the data provided to users in this section are also provided to the authorities although through a different interface as shall be seen later. The *View Area Safety* function is based on the previously mentioned *Violation Report* functionality. Which shall be clear as we describe the exact details of this function. In the *View Area Safety* function the user would specify a certain area in which he is interested in knowing the safety of. Then, the user is presented with a representation of the safety of the specified area. This is done formalized using the aggregated reports from various users of the system and graphically represented using the aid of map API.

2.5 Suggest Intervention

The following function along with the last function are provided to different class of users or to be more specific benefactors of the *SafeStreets* system. The described entity is the governing authorities in the different areas observed by the system through user reports. It is worth mentioning, that these two functionalities are achieved through a sort of mutual interaction between the *SafeStreets* system and the municipality. In which a municipality must first provide a means of communication or interaction, i.e., an interface in order for the system to provide these services. The *Suggest Intervention* service is the process by which the system suggests possible interventions to put into place by officials in certain areas; in order to decrease the number of violations which leads to accidents in such areas. To achieve this, the municipality must provide and interface to access the accident data in order to be coupled with the system's reports and also another interface to submit the suggestions.

2.6 Violation Report Communication

The last major function of the system is also one provided to the municipality. This service is simply the communication of the submitted traffic reports submitted by users while ensuring the secure transmission and ensuring that the data is not tampered with to a certain extent. This, can be done through the same interface which the system suggests possible interventions through. Moreover, the system could be provide more useful refined data to the municipality, such as, statistics on the different committed violations in various areas and most reported plate number.

2.7 User characteristics

The only actor of SafeStreet is the user, who can be explained in the following cases:

A user is a person who's aimed to facilitate authorities by reporting traffic violations in the city. The user registers to SafeStreet app, when any violation is observed, he/she takes pictures of the violating vehicle and along with the geographic coordinate sends it to the SafeStreet.

A user is someone who needs to obtain information about traffic safety in different areas of the city, the user can use SafeStreet in order to get this information from previously submitted reports, app displays information based on different areas of city using map API.

2.8 Assumptions, Dependencies and Constraints

In order to use SafeStreet, users are assumed to have a smartphone or tablet with capabilities of connecting to the internet, taking a picture and having a GPS sensor. More in details, the connection of internet via WiFi, 3G or 4G is needed to sent reports to the system, to recognize license plate and indicating occurred violations, users need to take pictures and send them to SafeStreet's server, finally to locate where the violation is occurred GPS sensor is used to get the coordinates of the violation.

This system is aimed to provide service throughout Italy, the privacy of the users is significant for the system, Thereby it observes General Data Protection Regulation(GDPR) legislated by the European Union.

3 Specific Requirements

3.1 External Interface Requirements

3.1.1 User Interfaces

3.1.2 Hardware Interfaces

The only external hardware interface worthy of mention in this section, is the user-owned mobile devices used in order to use the system features. Other than this, there are no other hardware interfaces neither provided by the system for external use, nor offered by an external entity and used by the system.

3.1.3 Software Interfaces

This system does not provide any software interfaces to external systems to access any of the system's various resources. It does however,offer user interfaces for the users to make use of the system features as previously stated. Moreover, some external interfaces are exploited by the system to retrieve and communicate data; which will be discussed in the communication interfaces section.

3.1.4 Communication Interfaces

As previously mentioned, the system uses the interfaces provided by the municipality to perform some of the main functions. The interfaces accessed by the system are as follows; firstly, an interface provided by the authorities for the retrieval of accident data. Said interface is used in order to couple the accident data with *SafeStreets* report data in order to decide upon appropriate interventions in order to decrease violation leading to accidents. To communicate the interventions along with other data to the authorities; specifically, details of aggregated reports and refined report data inferring some insights the system uses a second interface offered by the municipality for the submission of such data. Other than the municipality's interfaces all communication interfaces used by the system are internal interfaces used by the diverse system sub-modules in order to interact. Finally, it is noteworthy to mention that if the system is not provided the interfaces by the municipality it is impossible to communicate any of the previously mentioned data, since it is assumed that the system shall exploit the authority provided communication service to proactively provide this data.

3.2 Functional Requirements

3.3 User

3.3.1 General Functions

3.3.2 Violation Report

3.3.3 View Safety

3.4 Requirements

[G-1] Users should be able to report traffic violations

- [R-1] Users should be allowed to register to services provided by the system
- [R-2] Users should provide unique identification to the such as fiscal code during registration
- [R-3] Registered users should be allowed to login
- [R-4] Each registered user should have a unique username used for logging in chosen at registration time
- [R-5] System should enable registered users to report traffic violations
- [R-6] When reporting a violation, users should be able to take an image of the violating vehicle's license plate

- [R-7] When reporting a violation, users should be able to fill in the details of the reported violation such as the type of the violation
- [R-8] The system should be able to detect the current user location when reporting a violation
- [R-9] The system should extract the plate numbers from the image taken by the user
- [R-10] The received reports must be stored by the system to be used by other services
- (D_1) User provided image of traffic violations is not tampered with physically
- (D_2) User location included in report assumed to be the true unmodified location
- (D_3) Each plate number is unique and registered to only one vehicle
- (D_4) Each user's fiscal code is unique
- (D_5) User devices used for reporting violations has functioning a camera and GPS
- (D_6) The communication of data regarding reported violations to the authorities is assumed to be done proactively by the system
- (D_7) Plate number of violating vehicle is readable and clearly visible in images included in the report
- {NFR_1} The detection of plate number must be done in less than 1 second
- {NFR_2} The detected plate number is accurate 99% of the time
- {C_1} User location included in the report is assumed to be accurate within an error range of 10 meters
- {C_2} Image resolution/quality/size taken by users is at least X

[G-2] Users should be able to access information regarding the safety of different areas.

- [R-11] Registered users should be allowed to view a representation of the safety of selected areas possibly with the help of a map API
- [R-12] The system should implement a means to measure the safety of various areas based on reported violations in said areas
- [R-13] Incoming reports should be integrated and used to update the safety of areas
- [R-14] If accident reports are provided by authorities the system should take that data into account when calculating the safety of a certain area
- (D_2) User location included in report assumed to be the true unmodified location
- (D_9) The communication of accident reports by the municipality is assumed to be proactive
- {C_1} User location included in the report is assumed to be accurate within an error range of 10 meters

[G-3] Authorities should have access to the details of the traffic violations reported by the users.

- [R-15] The system should keep records regarding the submission dates of violations to the municipality
- [R-16] The system should aggregate the data regarding reported traffic violations since the last submission to the municipality

- [R-17] The aggregated traffic violation data should be converted to a form acceptable by the municipality interface
- [R-18] The system should periodically submit the new traffic violation data to the municipality interface
- [R-19] The system should be able to store submitted reports coming from users with proper meta data
- [R-20] The system should be able to export reported violations in form of specific file
- [R-21] The system should be able to filter data based on desired requests from authorities
- [R-22] The logging functionality has to be implemented in the system
- (D_6) The communication of data regarding reported violations to the authorities is assumed to be done proactively by the system
- (D_7) Plate number of violating vehicle is readable and clearly visible in images included in the report
- (D_8) The municipality is assumed to provide an interface for the submission of records of reported violations, refined insights produced by the system and suggested interventions

[G-4] Authorities should be provided with possible interventions to prevent violations.

- [R-23] The system should extract insights from the users' traffic violation reports such as the most frequent types of violations in certain areas
- [R-24] The system should be able to decide on appropriate interventions to minimize frequent traffic violations in the various areas
- [R-25] The system should formalize the interventions to be suggested in a form acceptable by the municipality interface
- [R-26] The system should submit the interventions regarding the areas with high frequency of violations to the municipality interface
- [R-27] The system has to be able to mine reports to find insights based on types of violation and different areas
- [R-28] The system should be able to recommend possible interventions to authorities in order to prevent violation
- [R-29] The recommendations has to be prioritized based on the entity od authority
- (D_5) User devices used for reporting violations has functioning a camera and GPS
- (D_6) The communication of data regarding reported violations to the authorities is assumed to be done proactively by the system
- (D_8) The municipality is assumed to provide an interface for the submission of records of reported violations, refined insights produced by the system and suggested interventions

[G-5] Authorities should have access to refined data related to committed violations.

- [R-30] The system should analyze the data from the reports to produce statistics such as the most frequent plate numbers that commit violations
- [R-31] The system should formalize the refined data and submit them to the municipality interface periodically

- (D_3) Each plate number is unique and registered to only one vehicle
- (D_5) User devices used for reporting violations has functioning a camera and GPS
- (D_6) The communication of data regarding reported violations to the authorities is assumed to be done proactively by the system
- (D_7) Plate number of violating vehicle is readable and clearly visible in images included in the report
- (D_8) The municipality is assumed to provide an interface for the submission of records of reported violations, refined insights produced by the system and suggested interventions

[G-6] Users should be able to view reports that they have previously made.

- [R-9] The system should extract the plate numbers from the image taken by the user
- [R-32] The system should present on demand to the users a record of all the reports previously submitted by them
- (D_4) Each user's fiscal code is unique

3.5 Performance Requirements

3.6 Design Constraints

3.6.1 Standards compliance

There are no standards constraints regarding the *S2B* design and implementation, apart from, the fact that the user interface must be implemented as a smartphone app in order to achieve the mobility required to report violations dynamically. Therefore, the decisions of implementation tools and languages used shall be left to the implementation team to apply the most effective methods given required functionalities.

3.6.2 Hardware limitations

As previously mentioned, some hardware constraints apply to the user owned devices that shall run the *SafeStreets* app. The following constraints apply in order to achieve full access to system features. Firstly, all devices must have a fully functioning camera capable of capturing images of previously stated quality; i.e., 3 megapixels. Moreover, the GPS system of such device must be functioning in order to locate users at time of violation report creation. Lastly, the devices must have enough free storage space to install the *Safestreets* app.

3.6.3 Any other constraint

The system must conform to general standard constraints such as not violating *Terms of Service* agreement provided to the user. Particularly, the constraints regarding users' sensitive data when communicating collected data to the authorities. Moreover, as previously discussed in details the users of the app must give their consent in order for the system to have access to the cameras and location when creating a report.

3.7 Software System Attributes

3.7.1 Reliability

For the system in hand, *reliability* could be viewed as a matter of providing an acceptable quality of service level. This could be achieved through numerous means, among which are duplication of the most critical system modules, using predictive maintenance to decrease the probability of failure and the consistent monitoring of the system, to name but a few.

3.7.2 Availability

As the case was for the *reliability* aspect of the system; *availability* is more of a general requirement to provide an acceptable quality of system; rather than, it being a critical requirement of the system. Therefore, it is sufficient for the system to have *3-nines availability*; i.e., be available *99.9%* of the time. This would provide balance between providing an acceptable quality of service and the increased system complexity needed to have higher *availability*.

3.7.3 Maintainability

A system constituted of multiple smaller subsystems, such as, the *SafeStreets* system should developed with the aspect of *maintainability* in mind. A modular approach for the different services and the interaction with external interfaces would be the most suitable approach for a system with such characteristics. Employing such an approach would make the process of diagnosing failures and fixing them much less complex. Therefore, increasing the measure of *maintainability* of the system.

3.7.4 Portability

Since the *SafeStreets* system is closely coupled with the geographic orientation of different areas. It must be able to adapt to a multitude of distinct environments starting from the route maps of cities where the app operates to the traffic regulations that my vary largely from one country to another. Moreover, it must provide a simple means of adding new authority controlled interfaces whenever it expands in the area under a new municipality.

3.7.5 Security

Unlike some of the previously mention system attributes, *security* is an extremely application critical aspect for this system. In addition, to the general security needs which most systems should take into consideration; in example, regarding the user personal data storage. It is imperative, to also take into consideration data security during transmission and during generation; i.e., the creation of the violation reports. This need stems from the fact that the generated and later communicated reports should be as reliable as possible. Since, they may be used by authorities to give out tickets. To achieve this goal, the encryption of data as well as the application of constraints on the report creation report is a must.