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Computer science and engineering
Software engineering 2 - Project 2019/2020

SafeStreets

Design Document

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Contents

1 Introduction

1.1 Purpose

The purpose of this document is going more in the technical details than the RASD concerning SafeStreets application.
The Design Document gives more details about the design giving guidelines over the overall architecture of the system. This document aims to identify the core design choices for developing the system:

- The high level architecture
- The components and their interfaces
- The design patterns
- The Interaction between the components
- Planning for implementation, integration and testing of the system

A mapping of the requirements to the architecture's components is also given in the underneath chapters.

1.2 Scope

1.2.1 Description of the given problem

SafeStreets is a crowd-sourced application whose intention is to notify the authorities when traffic violations occur. Citizens, thanks to the system, will be able to send information about violations to the authorities who will take actions against them. In this way, the service provided by the authorities can be improved because they will receive notifications through the app. The sources of notifications are the Citizens who take photos of violations and send them to the authorities through the application. The information provided by users are integrated with other suitable information and are stored by the service. The system also runs an algorithm to read the license plate of the vehicle in the photos. All collected data can be seen by Citizens and authorities to find which streets are the safest. Users can have different levels of visibility: authorities must be able to know the license plates of vehicles in the photos, while normal users can only see data in the form of statistics. Moreover, data are sent to the municipal district so that important information can be extracted through statistics in order to make decisions to improve the safety of the area. Finally, the system will have to be easy to use, reliable and highly scalable to fit perfectly with the mutable context in which it will be used.

1.3 Definitions, Acronyms, Abbreviations

1.3.1 Definitions

- Violation: parking violations which can be notified by Citizens to authorities
- Report: Notification sent by Citizens to the system
- Mapping System: external software that provides maps and directions to reach the position of a violation
- Licence plate Recognition Algorithm: calculation process that identifies the alphanumeric number on license plate
- Spam: a series of messages that are undesired
- App: application software

- Blocked: means that the account is banned for a given period
- Metadata: data about a violation. Position , date, time and the username of Citizen.
- Assignment : Work Request for authorities generated upon the receiving of a notification made by Citizens.

1.3.2 Acronyms

- RASD: Requirement Analysis and Specification Document.
- DD: Design Document
- API: Application Programming Interface
- GPS: Global positioning system
- HTTP: HyperText Transfer Protocol
- HTTPS: HyperText Transfer Protocol over Secure Socket Layers
- UML: Unified Modeling Language
- JSON: JavaScript Object Notation
- UI: User Iterface
- SQL:Structured Query Language

1.3.3 Abbreviations

Rn : n-th requirement.

1.4 Revision History

- DDv1.0 delivered on 9/12/2019

1.5 Reference Documents

- RASD version 1
- Specification Document: “Assignments AA 2019-2020.pdf”.
- IEEE Standard for Information Technology—Systems Design—Software Design Descriptions

1.6 Document Structure

This chapter debates about contents and structure of DD, indeed this document is divided in seven different sections:

1. The Introduction provides a general appearance of the systems defining which are the goals to reach.
2. Architectural Design: This chapter illustrates the main components of the system and the relationships between them, supplying information about their workflow and deployment. This part of the document also focuses on the main architectural styles and patterns.

3. User Interface Design: This chapter provides a general idea of how the user interfaces will be structured.
4. Requirements Traceability:This chapter explains how the requirements defined in the RASD are correlated to the design elements that are defined in this document.
5. Implementation, integration and test plan: This chapter identifies the order of implementation and integration of the various components of the system. The testing of those components is also described in this chapter.
6. Effort Spent : This chapter shows the amount of hours spent by each member of the group to write the document
7. Appendix : In this chapter the tools used to create the documentation are listed.

2 Architectural Design

2.1 Overview: High-level component and their interaction

The SafeStreets App is a distributed App with three logic software layers. The Presentation layer wich manages the interaction of the user with the system and is responsible of maintaining the GUI, the App layer which handles the logic of the App and its functionalities the last layer is the Data access layer which manages the accesses to the database and allows the separation of concerns between business logic and data. This so called three-tier architecture is thought to be divided on three different hardware layers that represents a group of machines so that every logic layer has a dedicated hardware. This architecture makes it possible to guarantee scalability and flexibility of the system and also lighten the computational load of the server splitting it in two different nodes.

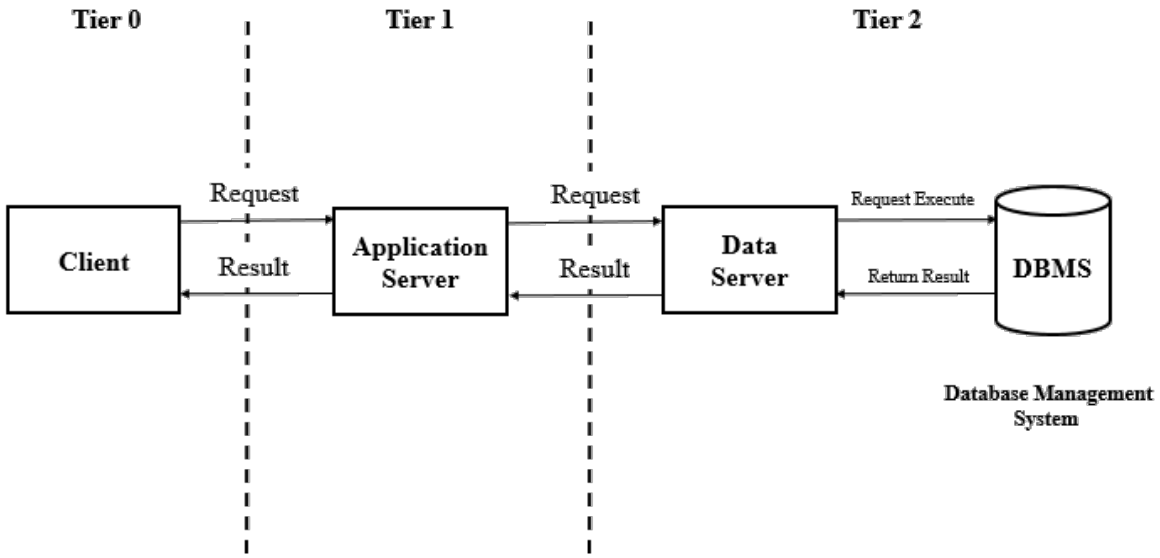


Figure 1: Three tier architecture

This architecture improves also the security of data since users can't access directly the data layer, but have to communicate with the App layer that will retrieve only the necessary data. Citizens access the system using their mobile phone App , which communicates with the App layer to send reports and get statistics; authorities can access the App in the same way as citizens do, but they can also receive assignments, see reports and take on assignments and finish them. The server of the App layer sends push notifications in asynchronous way to the authorities to warn them about violations in an area. Municipality and System manager communicate with the App layer to add new municipality and authorities to the system, to retrieve statistics and to read suggestions for improving safety on streets. The App layer communicates with data access layer synchronously to obtain information and asynchronously to store information about violations. This kind of architecture allows the server nodes to be replicated in order to improve the system scalability. Replicating nodes adds the need for a new component in the architecture, the load balancer, that is responsible for distributing the working load among the replicated nodes. This Approach also increases the fault tolerance of the service since a fault in a node doesn't affect the service availability. An error in the system may increase the work load for the other nodes, so the number of replications should be decided considering also this possibility to avoid the creation of a bottleneck due to a fault of the server. To assure security of data managed by the system the server has two firewalls to check packages exchanged with users. They both filter packages incoming and going out of the App logic one towards user devices and the other towards the data access layer.

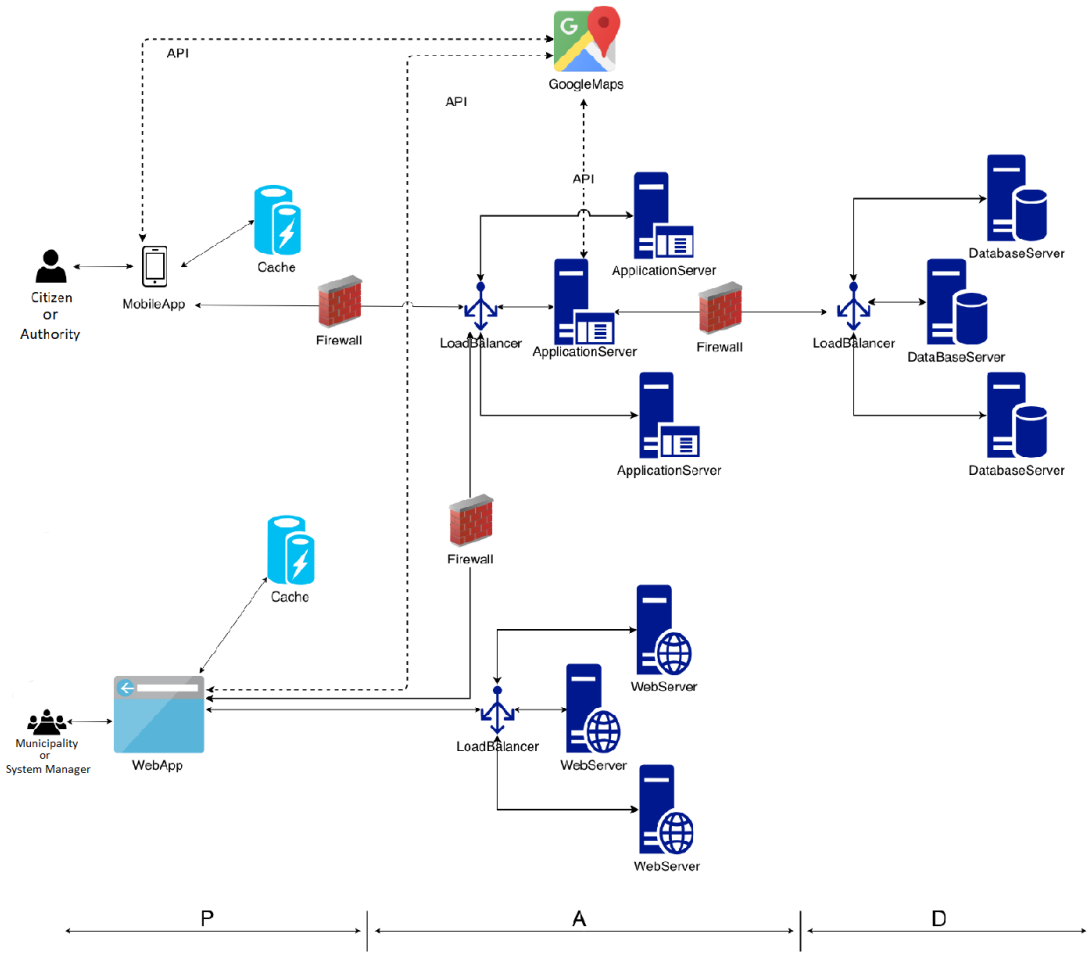


Figure 2: Application High Level Architecture

Citizen and authorities are provided of mobile Apps to access the functionalities offered by safestreets. Municipalities and system managers communicates with safestreets using a web App. The App layer is divided in two parts, one which sends static data (HTML,CSS,Javascript) to web App and another part which communicates with database and provides users dynamic contents. Our system uses only few caching capabilities because lot of data is dynamic and chages continuosly. The only information we cache are those about the violations when an authority takes the corresponding assignment; citizens have in cache the list of reports they have done and can choose how long that list would be kept in memory. For scaling purpose a non relational database could be used in later releases to collect data from databases with different structures and then use mining techniques to find useful information and pattern in recurrent violations and information. This could be useful to build statistics that may be queried on a regular basis and stored in a location which is faster to access for our system, reducing the number of queries to be done to external databases.

2.2 Component view

In this section we present the components of SafeStreets we start from a generic point of view showing the main parts which composes our system and then we divide the system in smaller parts to analyse the behaviour of the single components and their subcomponents.

2.2.1 General Component view

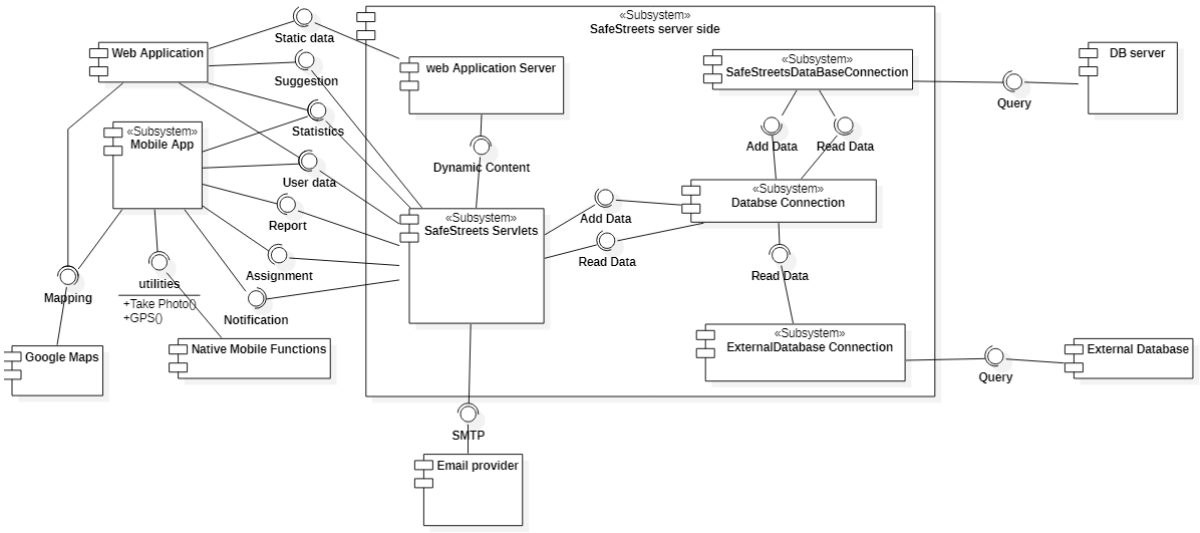


Figure 3: General Component diagram

In this diagram we represent a high level logic view on Subsystems and components. We show the interaction between the server and mobile App,web App, email provider and databases. The server is composed of five SubSystems and components:

- SafeStreets Servlets: this contains all the Servlets which allow the user to communicate with the server. To retrieve and save data this component communicates with the Database Connection subsystem. All responses to the user are sent in JSON format.

- Web App Server: this component provides the web App the static data of the App (HTML,CSS,JAVASCRIPT), this part is separated from SafeStreets Servlets for the sake of separation of concerns, dynamic content and static contents are different so different components should get request to retrieve them.

- DataBase Connection: this component acts as a facade which separates servlets from data access logic. This component communicates with SafeStreets servlets providing them the functionalities to access data. It communicates to Connection subsystems which communicates with SafeStreets Database and with External Databases to get data which is required by users.

- SafeStreesDataBaseConnection: this component communicates with SafeStrees database executing query to update and read data from it and provide data to DataBase connection component.

- ExternalDatabaseConnection: this component communicates with External databases executing query to read data from it and provide them to DataBase connection component.

SafeStreets Servlets communicates using SMTP protocol to send emails to users who have created a new account or have forgotten their credentials. It also communicates with Mobile App and Web App providing them with Access to their account data, the possibility to make reports for Citizens, to take assignments for the Authorities, to read suggestions for Municipalities and to see statistics for every type of users and visitors. The server also communicates with databases to retrieve and save data about violations, users and accidents. Mobile App and web App communicate with Google maps API to get maps to show to users. Mobile App also needs to communicate with functionalities given by the device such as taking Photos and obtaining position using GPS

2.2.2 Mobile App and Web App Component view

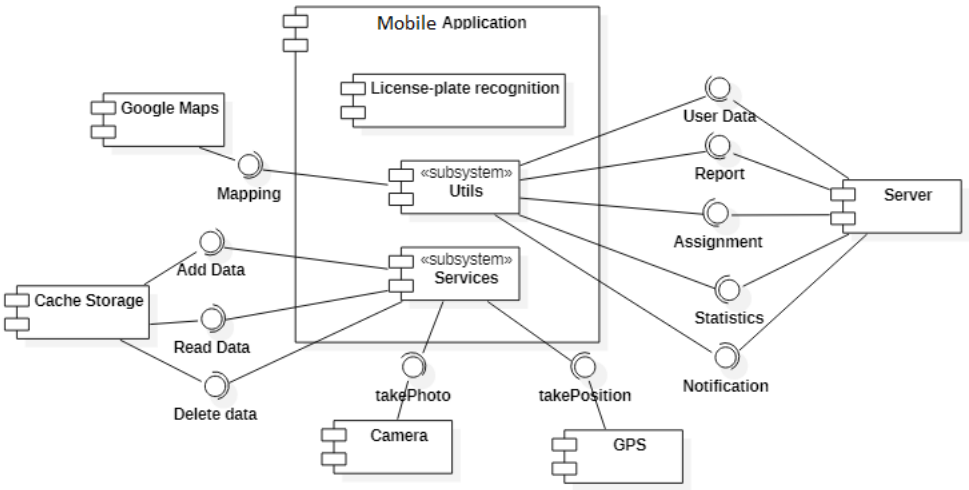


Figure 4: Mobile App Component Diagram

In this image we show how Mobile Apllication Subsystem can be seen in more detail. There are two main components :

- Utils: this component takes care of the communication of the App with SafeStreets Server and Google Maps mApping API.
- Services: this component communicates with Mobile phone's services which are needed for our App. Those components are GPS which is used to retrieve user position, the phone camera user to take photos of the violations and cache storage used to save locally some useful informations both for Citizens and Authorities.

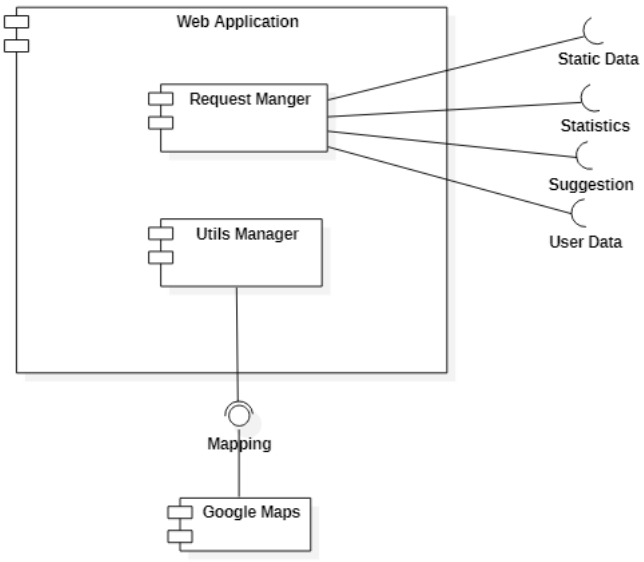


Figure 5: Web App Component Diagram

Web App works in a similar way to the mobile App. It must retrieve static data from webServer differently from mobile App.

2.2.3 Server Servlets Component View

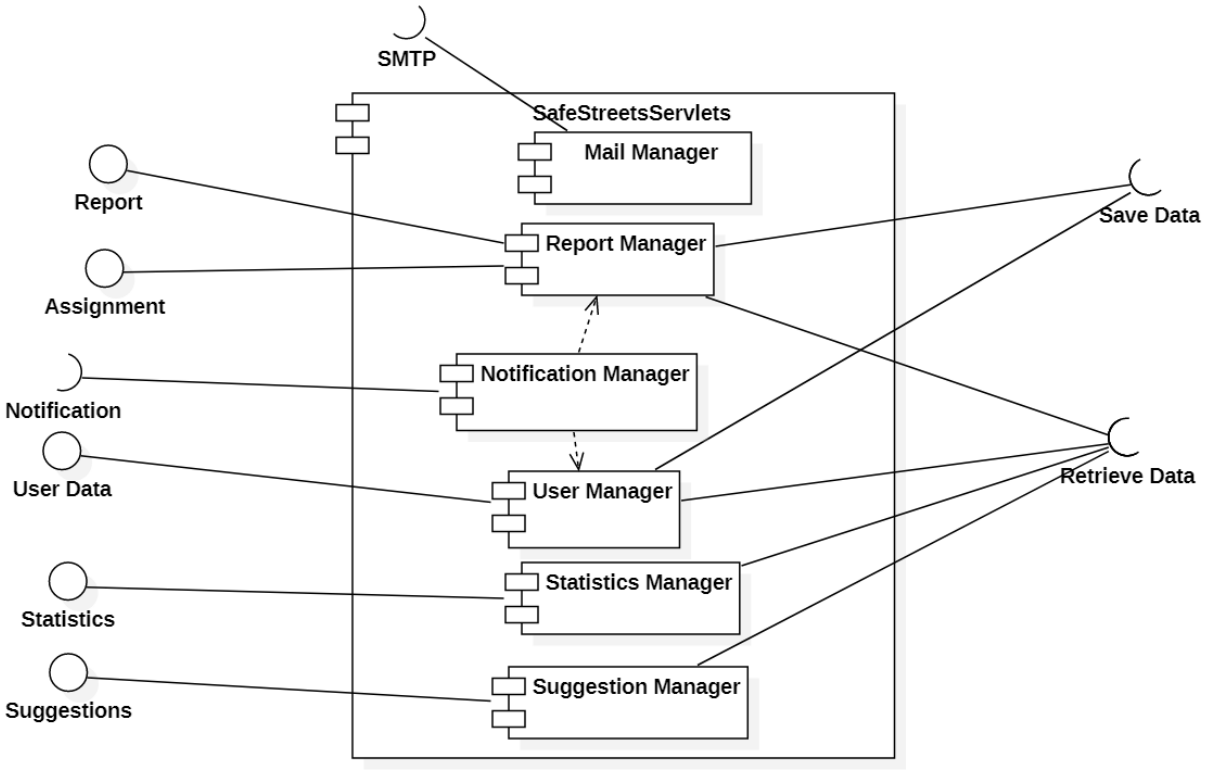


Figure 6: Servlets Compent

SafeStreets Servlets component is composed of 6 Managers:

- Mail Manager: this component allows the system to send email to Users when they create account or they modify their credentials. This component is associated with user manager which informs it when an account creation or modification is successful.
- User Manager: this component allows users to create and handle their account informations. They can create a new account, modify their data and Login. In order to allow these functionalities, this component must be able to both save data and retrieve data from database.
- Report Manager: this component allows citizens to create reports and manage them, and also allows Authorities to take assignments and terminate them. It communicates to the notification manager when new Assignments are created.
- Notification Manager: this component sends notifications to the authorities about new violations. It requires the Mobile App to open a websocket to communicate.
- Statistics Manager: This component retrieves data to make statistics requested by Users and visitors.
- Sugggestion Manager: This component retrieves suggestion requested by Municipalities.

All components take and save data using interfaces exposed by DataBase Connection component.

2.3 Deployment view

In the following image the deployment diagram for SafeStreets shows the distribution of the system components and the different deployment nodes. We used a different color to represent External Database servers to show that the node is different, that's because the system should not implement these node but should only communicate with it. Google Maps API and Email Provider are not shown in this diagram to simplify it and because their interaction with our system are described in component view.

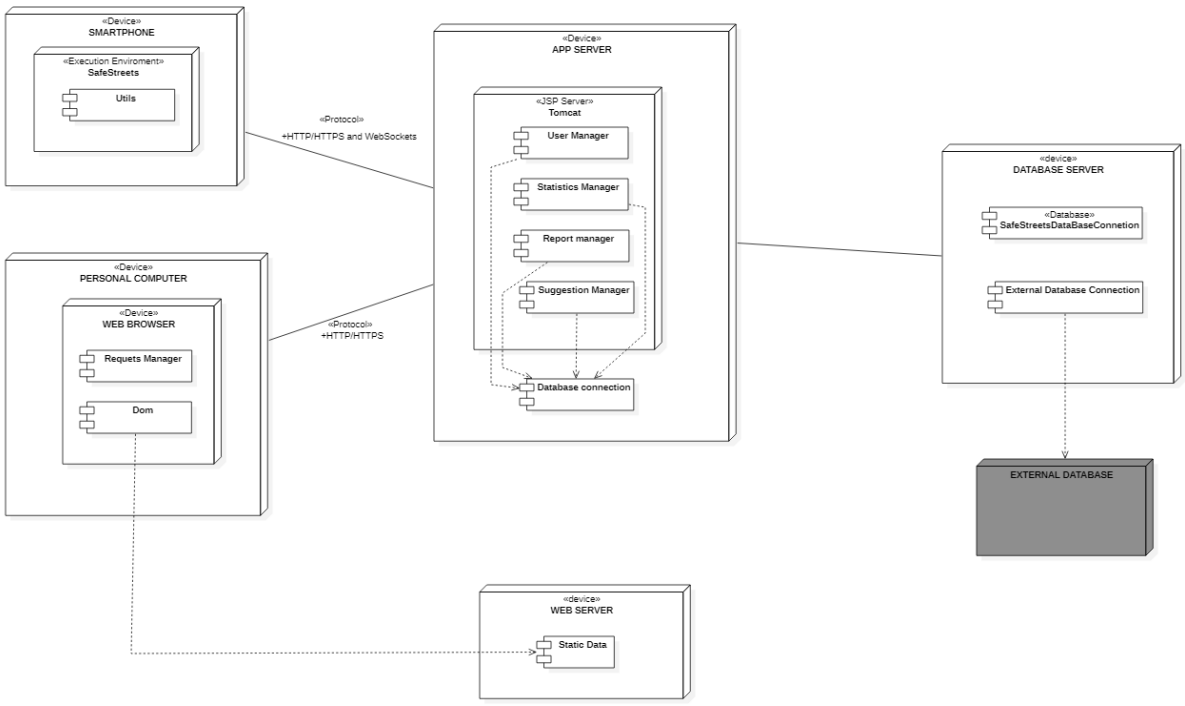


Figure 7: Deployment Diagram

This Diagram is divided in three sections to show clearly the separation of the different layers of the App:

- Presentation : this layer contains the presentation logic. Users to access data must be provided with mobile App for Citizens and Authorities, with web App accessible by a web browser for municipalities and system managers. Mobile App must be available for both Android and iOS but not just newer versions to make the App the more accessible as possible, for the same reason web App should be compatible with major desktop web Browsers: Google Chrome, Mozzilla Firefox, Safari and Microsoft Edge (at the time this document is being written). Communication happens using HTTP and HTTPS for both devices while it also happens through WebSockets for mobile App push notifications.

- BusinessLogic: this layer is divided in 2 different nodes types. The first one is the web Server which communicates with web App and sends it static data needed to render static components (HTML,CSS,Javascript). The second one is the App Server instead it allows users of both type of App to access dynamic data acting as an intermediary to separate presentation and data but also to control access to data.

- Data Access: This layer executes a relational DBMS and provides functionalities to the Business logic to access data requested by users. We show in this layer also the external databases which are another important source of data for SafeStrees. Regarding this component at an initial phase

the server will access using the provided interfaces those external databases. When the App will grow a different approach must be implemented to preserve performances by reducing requests to external systems. To reduce this burden a non relational Database internal to safeStreets may be used to store information from external databases using those as sources to create datamarts and use technologies optimized for Big Data. Using this Approach will add a recurring activity to be performed which is mining this non relational Database to build suggestions for municipalities.

2.4 Runtime view

2.4.1 Make a report

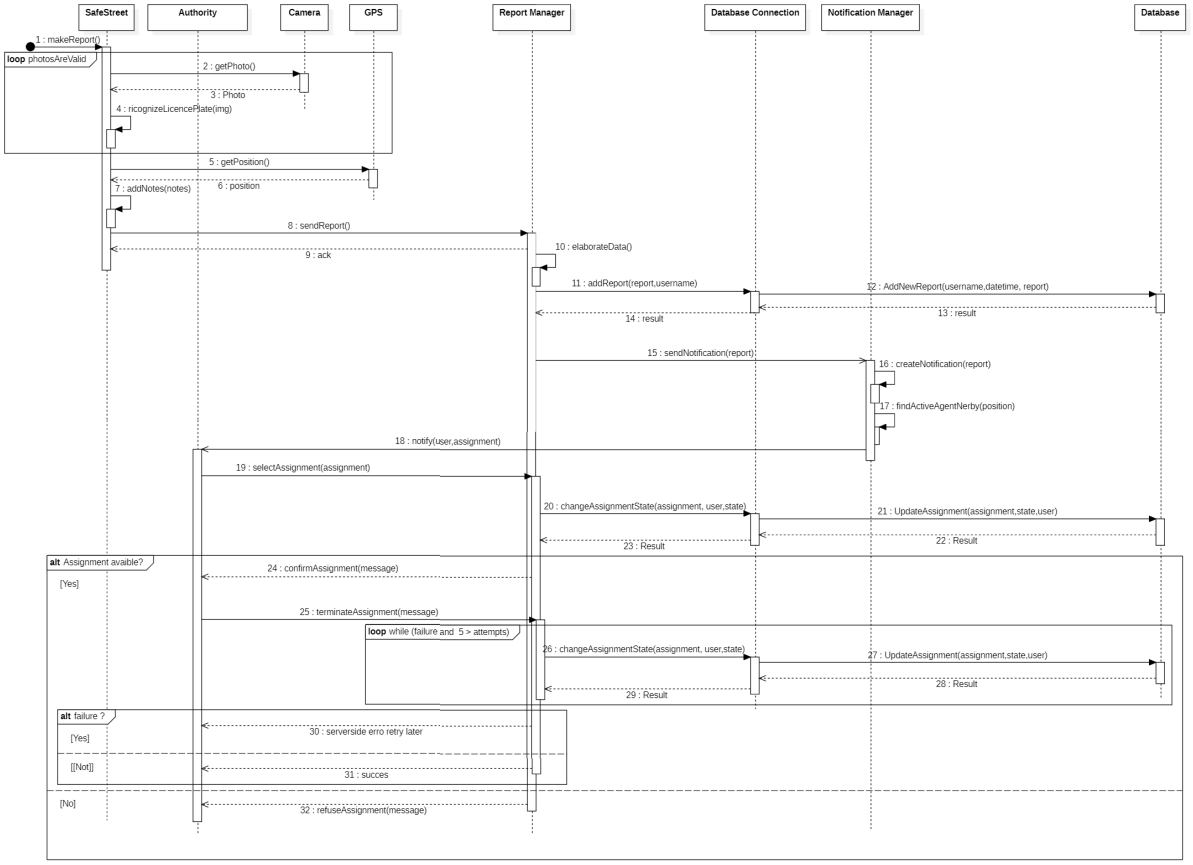


Figure 8: Sequence Diagram: Making a Report

In this sequence diagram the process through which a Citizen makes a report , the request is handled by server and how the authority is informed and can take the assignment corresponding to the report is shown. When the Citizen clicks on the Button " Make a Report" of the main creen the phone camera is opened automatically, so user is asked to take the first photo of the violation. After taking the photo it is elaborated with the Algorithm to Recognize Licence Plates if it recognises a licence plate the App gets using the GPS of the App the position of the user , in case of no recognition the user is asked to take another photo. To enrich the Report the App allows the user to write some additional notes that authorities can read and get more information about the violation. Then when the user decides to send the violation clicking on the corresponding button on the UI of the mobile phone the App handles the request and sends the report and all the needed data to the Report Manager.The Report Manager elaborates the data and sends the report to the DatabaseConnection subsystem which takes care to add the report to the DataBase, in this diagram we don't show the SafeStreets database connection subsystem to lighten the diagram and also because it would be called with the same request as the DataBaseConnection resulting in no useful information being added. The Database recognizes if the report is new and creates a new Assignment if it doesn't exist , it just adds a report connected to the assignment if it already exist. After that the Report Manager sends the notification to the notification manager which takes care to find the closest agents to thte report and to warn them using push notifications of the assignment. The warned authority, who can decide to take the task, in case of acceptance sends a request tot the Report Manager that checks if the Assignment is still available in the database in that case it modifies the state of the

assignment and confirms the authority to take charge of the assignment if it was still available otherwise a refusal message is sent to the Authority. Once the Authority terminates his assignment he can notify the system using the Button "Stop Assignment" after that the App asks the User how the assignment ended and the type of violation. Those data are sent to the Report Manager who modifies the state of the Assignment accordingly If the modification is successful the Report Manager notifies the user otherwise it retries this operation 5 times and than in case of failure it sends an error message to the authority notifing him/her that there are problems in the server and asks the user to retry later to terminate the assignment.

2.4.2 Login from Mobile App

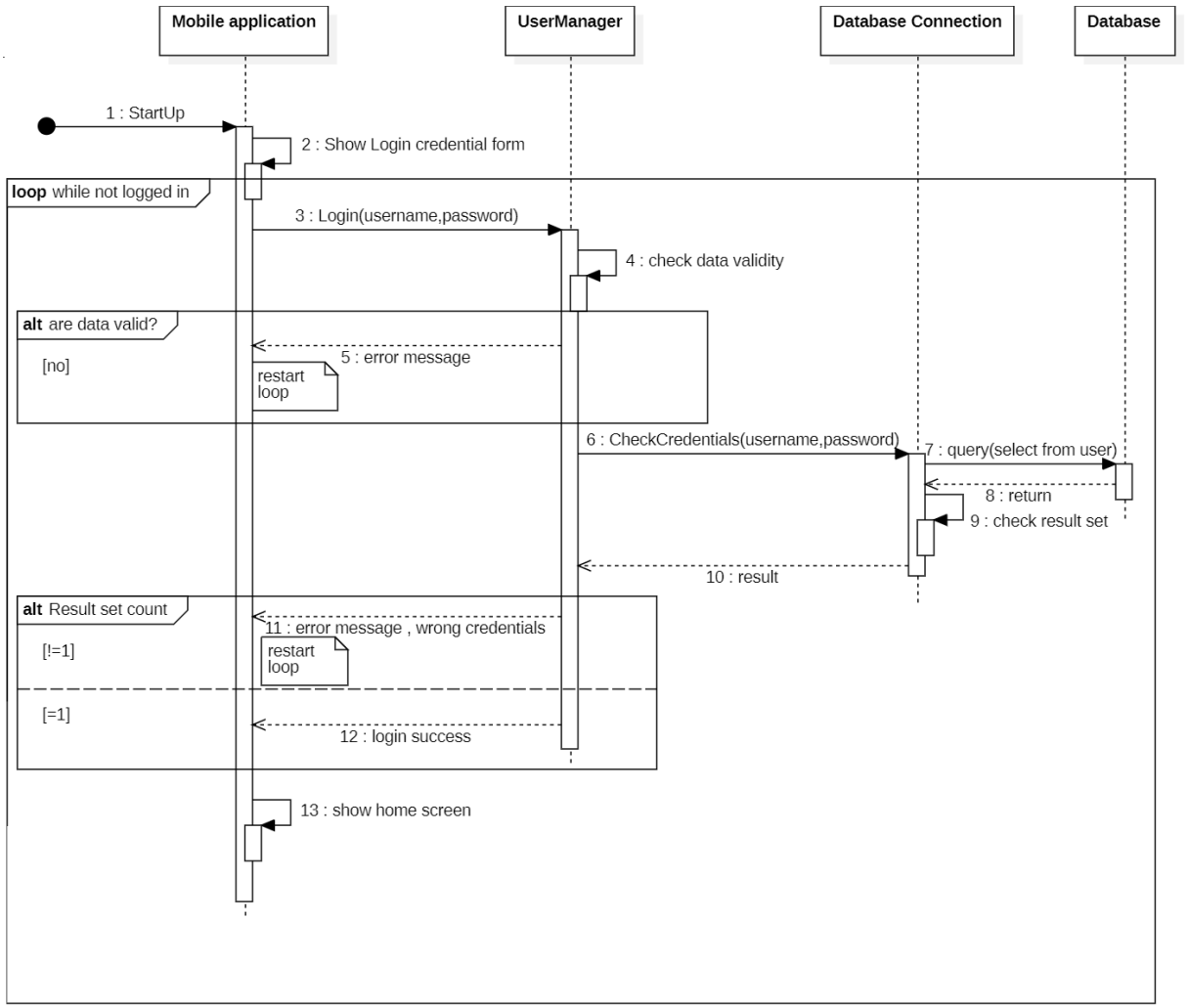


Figure 9: Sequence Diagram: Mobile App Login

In this sequence diagram the process through which a User can Login, it shows the Mobile App process but it is the same for the Web App. Once users gets access to the App(Mobile or Web) they are asked to autenticate themselves in the "Login Page" inserting their credential in the dedicated text fields. Once the user submits the data pressing "Login" button data are sent to User Manager that takes care of the verification of data validity, in case of failure an error message is sent to the user who must repeat the autentication sequence otherwise the User Manager asks the Database Connection subsystem if the credentials are associated with a user also here as in the last diagram the SafeStreets DataBase Connection

subsystem is not represented because it wouldn't add relevant interaction for the App. If a user is found associated to the inserted credential the user is logged in and the homepage is shown to the user otherwise the login request is refused and the user is notified that the inserted credential are wrong and he/she must retry the Login process.

2.4.3 Authority registration

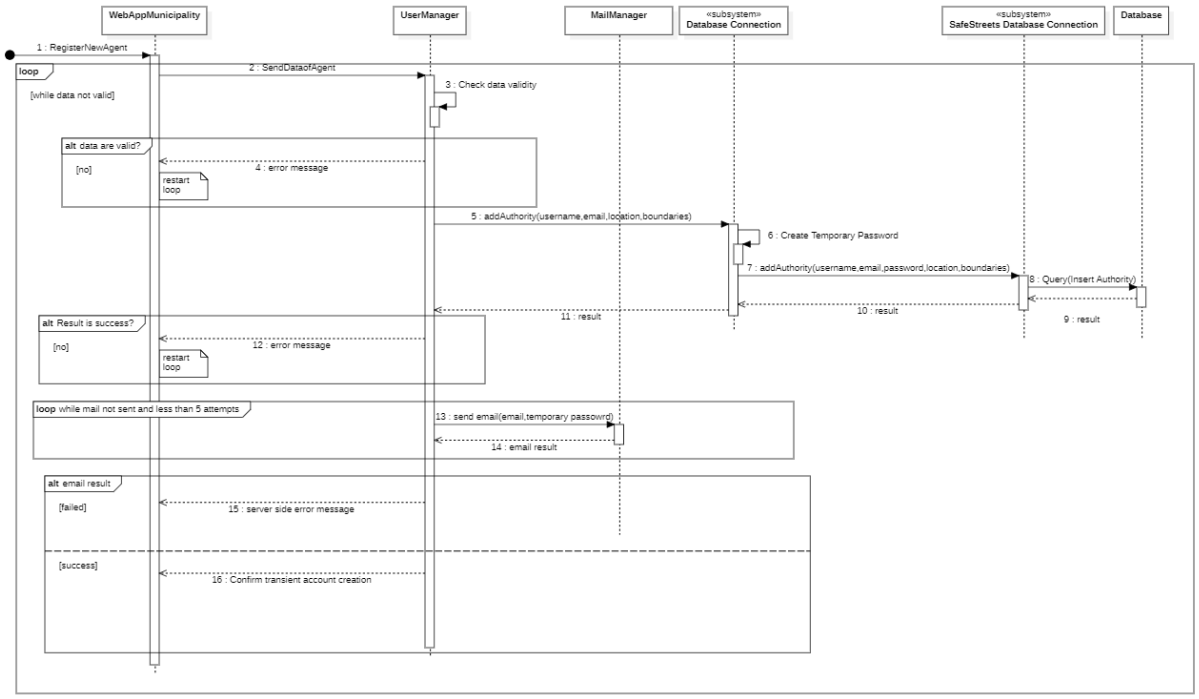


Figure 10: Sequence Diagram :Authority Registration

This sequence diagram shows the process of the registration of a new authority to SafeStreets service. The registration of an authority must be done by a Municipality pressing the "Add Agent" button in the Homepage of Web Application , after this the application shows a page for registrating a new authority , this page contains a form to be compiled with data caracterizing the authority(his/her email adress, username, and the boundaries of the area he/she takes care of). After that the Municipality sends the request to add the agent using the "Add" button, this sends the data from the form to the User Manager which checks if data are valid. In case data are not valid an error message is sent to the municipality that must refill the form and redo the registration sequence. In case data are valid they are sent to the database conncetion which generates a temporary password for the authority account , after that the SafeStreets Database Connection subsystem checks the existence of an account with the same username. If there is a matching username already in the database the new authority is not registered and the Municipality gets an error message. If the creation is successfull the User Manager asks the Mail Manager to send an email with the temporary password to the Authority . If the email isn't sent and the server fails 5 times to send it, the server informs the Municipality that there are problems with the email and that the server will take care of sending the email if the authority didn't receive an email or in any case if he/she doesn't login within 24 hours. If the email is sent succesfully then authority is informed of the success of the creation of the authority account.

2.5 Component interfaces

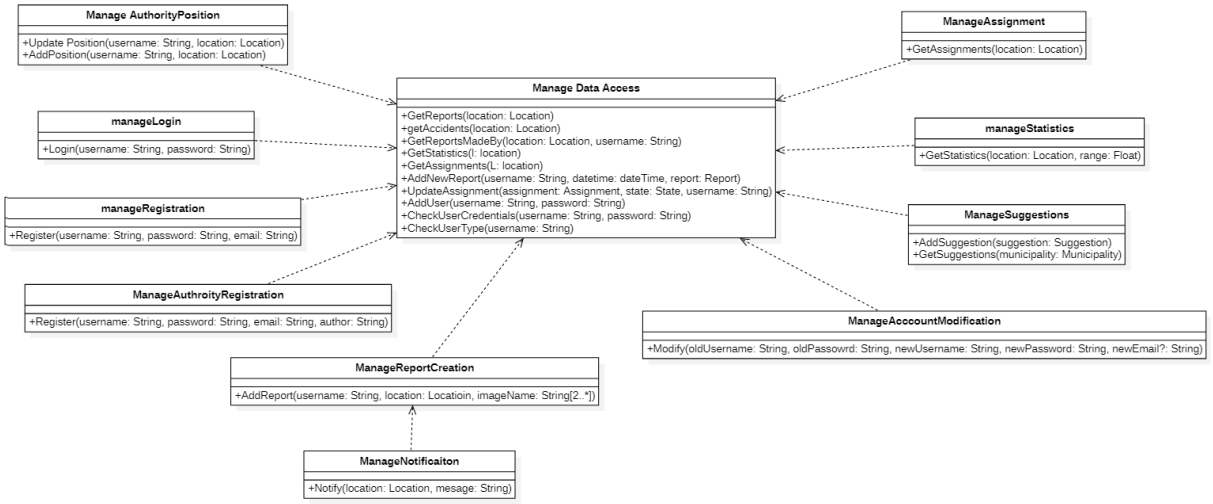


Figure 11: Component Interfaces

In the above picture the component interfaces of the business logic and the facade provided by data access layer are shown. The arrow represents dependencies between interfaces . All Interfaces except for ManageDataAccess and ManageNotification are required by the web servlets to respond to user Requests. Manage Data Acces acts as a facade provided by the Data Connection component and provides the other interfaces the needed data to respond. Manage Notification takes care of the notification sent to authorities , it need the Manage Authority Position interface that informs it when an authority moves from one position to another and also it needs the ManageReportCreation that communicates to ManageDataAccess interface to create a Report object and when the object creation is successful it asks to send notifications to every authority who is active near the location of the report. Those interfaces are provided by the Manager components of the system:

- User Manager: provides ManageLogin,ManageRegistration,Manage Authority Position, Manage Authority Registration and Manage Account Modification interfaces
- Report Manager: provides the ManageReportCreation and manage Assignment interfaces
- Notification Manager: provides manage Notification interface
- Statistics Manager: provides Manage Statistics interface
- Sugggestion Manager: provides Manage Suggestion interface

In this diagram we used the symbol '?' after newEmail in ManageAccountModification to indicate that the old email isn't modified if it not specified by the user. This difference is done to show how all other parameters must be provided by the Servlets which gets them from users and are mandatory for the functionalities to work. The most important interfaces needed by servelts to provide user the main functionalities of SafeStreets are:

- ManageReportCreation: this interface allows the Creation of requests, it needs the username of the user creating it the location of the Violation and the photos associated with it which must be more than 2 [2...n]. It creates an object of type Report and uses the method provided by Manage Data Access to create a new report in case of failure the user is notified, in case of success two different scenarios may hAppen, the report is linked to a new assignment or the report is linked to an

already existing assignment, if the already existing assignment is being taken care by an authority the server communicates that to the user who reported the violation in all the other situations the Notification manager is asked to send notification to agents near the location of the violation and are asked to take the assignment.

- ManageAssignment: this interface allows authorities to find all the pending assignments which are close to their position
- Manage Suggestions: this interfaces is maily used to allow Municipalities to Get suggestions. Suggestions are made combining Report data and accident data close to the location of the municipality. In addition to dinamically created suggestions Citizens and authorities are able to send suggestions when sending reports for the former or terminating assignments for the latter.

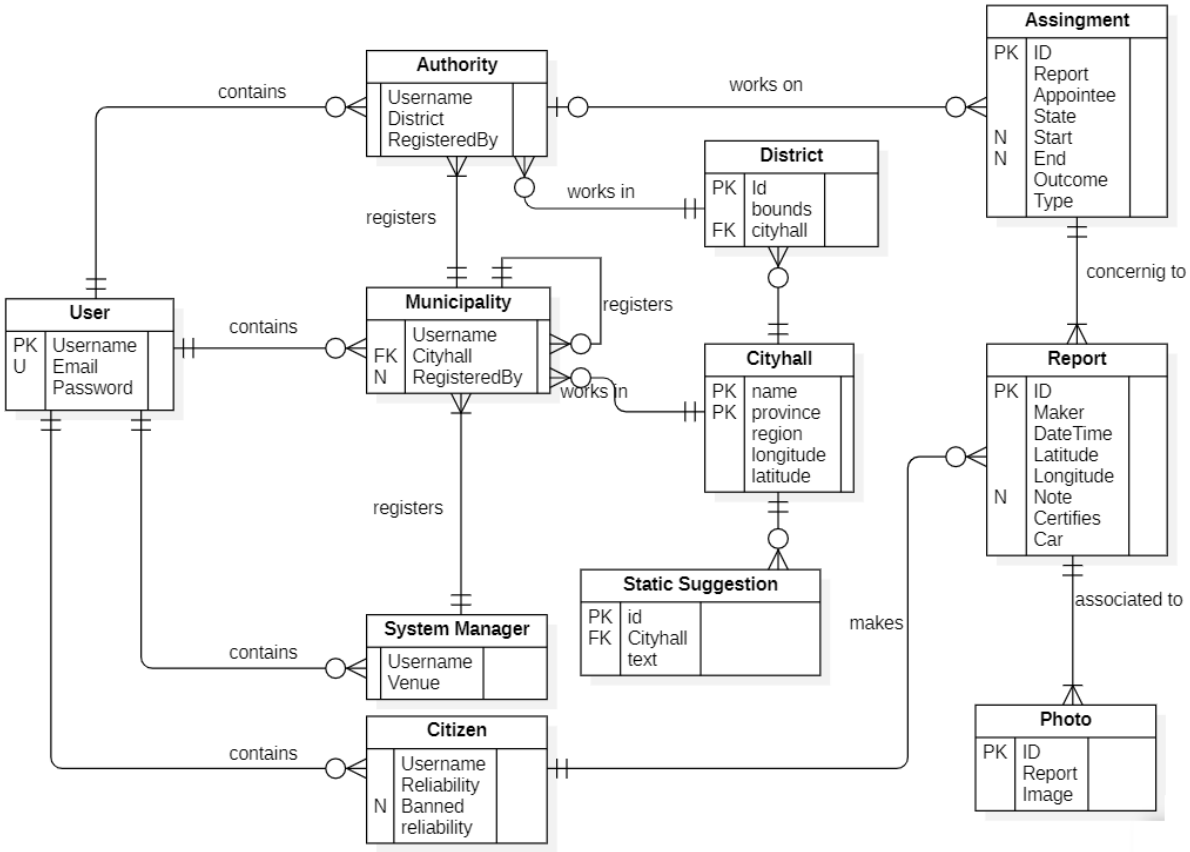


Figure 12: ER DIAGRAM

The image above represents the Entity Relation diagram of data saved on the internal database of SafeStreets. The Different kind of users all have as primary key their username, a unique email is requested for different users because when user account informations gets modified or credential are lost the right user must be notified by eamil. Municipalities have a nullable field RegisteredBy which is used to keep track if an authority registered another authority and who registered them, it can be null if the registration hAppens trough the system manager. To facilitate access to authorities and municipalities in a certain location the cityhall table is used , this table must be indexed using longitude and latitude as indexes to making access to the table faster, Static Suggestions added by users and authorities must be indexed using Cityhall as an index to make easier access to suggestions. Report contains a field for notes made by users to authorities to give them information they couldn't provide using photos. Citizens have a reliability field which represents how reliable a user is , this is used by database to ban a user when they make too many fake reports or they create too many reports in a really short time.

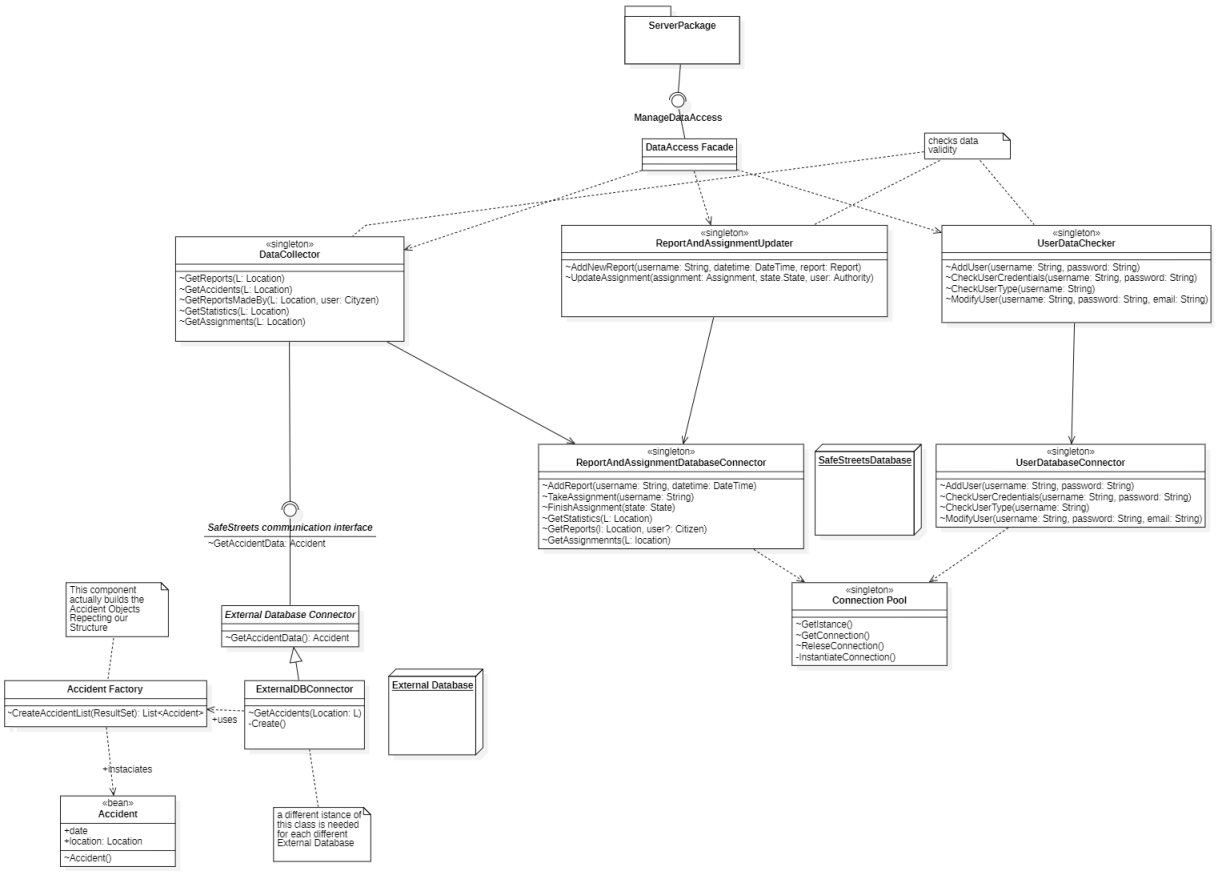


Figure 13: Dabase Connection Class Diagram

In this picture a part of the class diagram concerning Data Access Layer is provided. This component provides the Business Logic (here shown as a package, the ServerPackage) an interface to access data. Internally different singleton classes handles the requests a first group of classes checks input data validity :DataCollector, ReportAndAssignmentUpdater and UserDataChecker. The first one communicates with Report And Assignment Database Connector to get report ,assignment and statistics from SafeStreets Database and also communicates with different External Database Connectors to get Accident data from external Databases. To communicate with external database the system has an abstract class of connector which contains the methods required by the system, for every database a different istance of child class is needed to implement the actual connection and in case some information need further computation a factory class is needed to create Accident istances which can be used by the business logic. A connection Pool for Connecting to SafeStreets Database to allow the reuse of connection and reduce the cost of memory allocation and disallocation in the server.

2.6 Selected architectural styles and patterns

2.6.1 Multiple Servlet server

We have chosen to use a server which provides multiple servlets to create different access points to the server for different requests. This allows us to make server manage different tasks using components that have few but specific functionalities, reducing the amount of interactions between them. This Approach allows the implementation and testing of components in parallel. The only components that must be developed and tested in advance are Database and its access components. Once those components are completed and their functionalities are tested, it is possible to develop different functionalities of the server in parallel, so the components must be tested and then integrated with the database access compo-

nents. Moreover, this Approach allows us to make the system scalable: different functionalities may be separated in different hardware components and routing devices may be used to send the request to the right machine which can satisfy the request. The system can also be expanded in a really simple way: if we want to add new functionalities, new independent servlets can be added to manage them and a new manager to handle the request and send it correctly to the database connection components; as an alternative, an already existing component may be expanded to do it. Since different functions of the server are separated, in case some functionalities aren't working in the correct way, it is possible to pinpoint the parts of the system which aren't working correctly and fix them. For this Approach to work it is really important that the Database access components work correctly; in fact, a bug in one of those components would affect the overall App, making later maintenance more costly. So it is really important that all the functionalities of this part are tested; moreover, the documentation must be as clear as possible to allow future maintenance and expansions as simple as possible.

2.6.2 Three Tier Client-Server

The separation of the system in three different layers allows to makes the system more flexible and reusable. Together with the multiple Servlet Approach it allows to add functionalities and modifing them without affecing the entire App. This also allows the separation of the presentation of data to the user from data access using the App layer to block access to informations that a user should not access(I.e. a citizen should not access photos of violations or assignment lists)

2.7 Other design decisions

2.7.1 Thin client

A thin client is characterized by the fact that it's only function is to communicate with server to retrieve data and concentrates on presentation of data to the user.
This design choice allows us to separate the business logic from the presentation. However our Mobile App has some business logic in it so it is not purely a thin client. This choice is made to reduce drastically draining computational resources from server. The business logic in the App is the Licence plate recognition algorithm which checks if at least one photo provided by the user contains a valid licence plate, doing such a control server side would have needed to send all the photos to the server to check them and in case of failure notify the App of it and ask the user to re-take photos and send them again to the server, considering also that those kind of algorithm can take lot of time to be executed. To clarify this statement this example may help to understand our choice: an execution time of a millisecond on a mobile phone may be seen as a bit of lag by the user but if the algorithm runs on the server that millisecond of delay which must be mutiplied by the amount of users sending photos and the number of photos sent by them can result in a delay of seconds in the performances of App server Nowadays it is important to consider a lot those kind of delay since users can access any kind of App and user experience while using an App is crutial, a delay of just a couple of seconds can make a user uninstall completely an App and also discourage other people from using it.

3 User Interface Design

3.1 UX diagrams

The mockups of the application were already exposed in the RASD document.
We present UX diagrams showing the flow all type of users interacts with the system. There are repetitions in diagrams to show how mobile application users have lot of common interaction but also web app users have lot of interactions in common. Every user when application starts up can login or ask to retrieve his/her lost login credentials. All user can also access statistics and modify their account's data and credentials. The differences are in some screen available only for specific type of users. Citizen can create new account and make reports, authorities can take assignments and terminate them, municipality can register authorities but can also see suggestions , system manager and municipalities can register new municipalities.

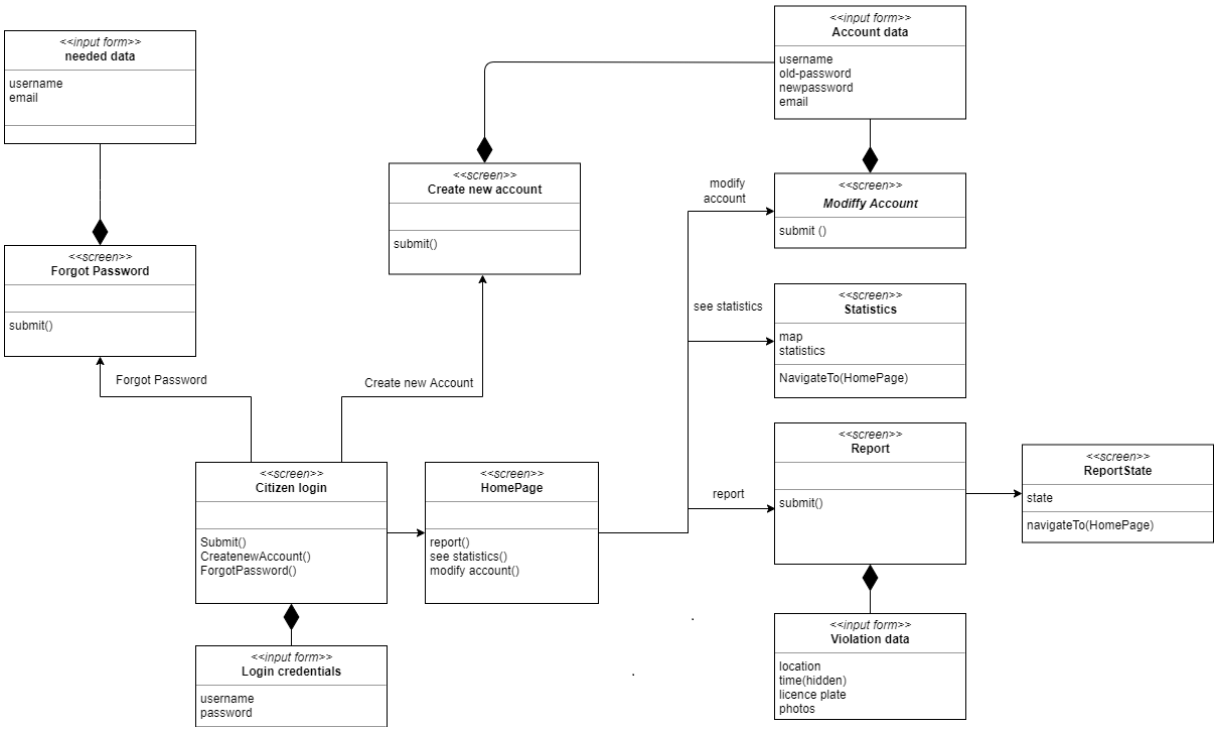


Figure 14: Citizen UX Diagram

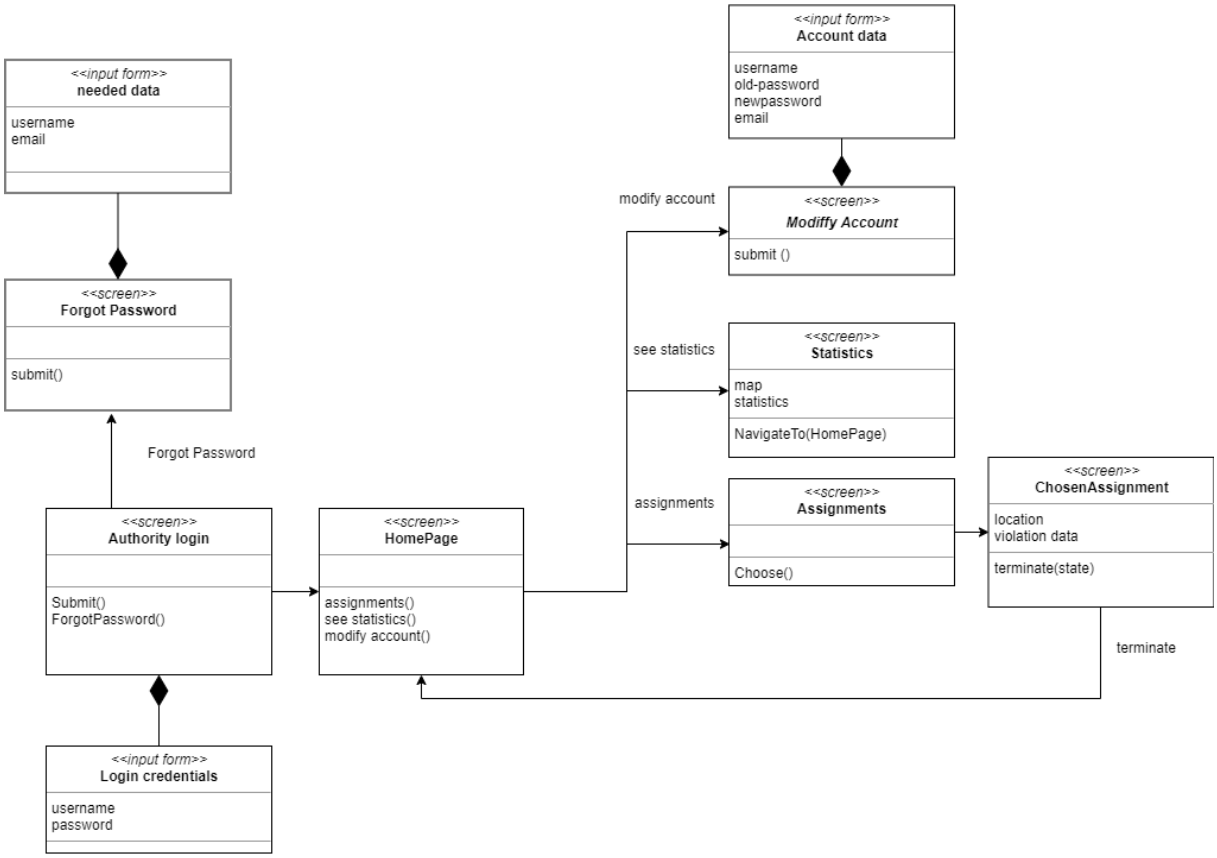


Figure 15: Authority UX Diagram

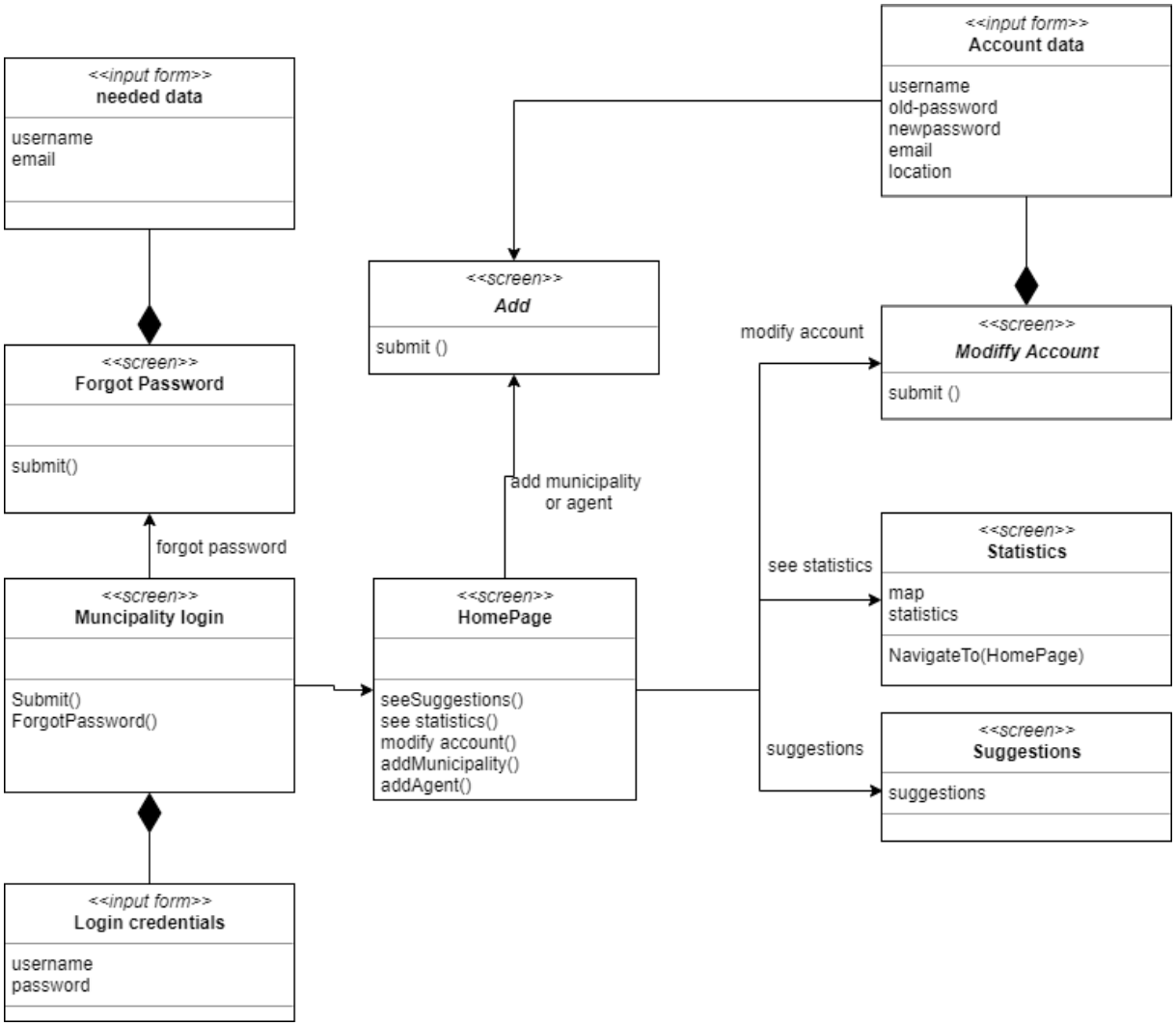


Figure 16: Municipality UX Diagram

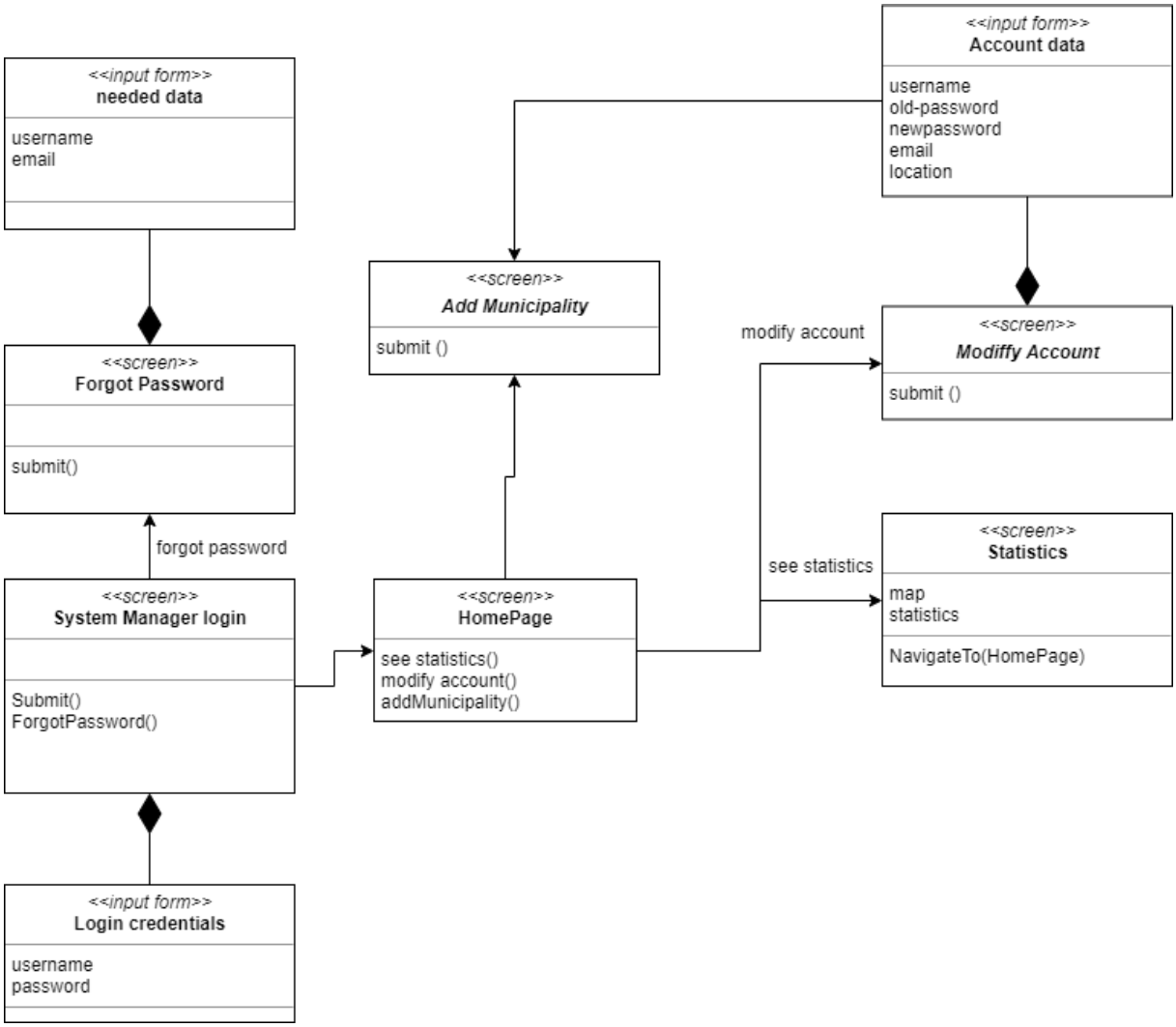


Figure 17: System Manager UX Diagram

4 Requirements Traceability

The DD is thought to guarantee that the components of the system are able to enforce the requirements presented in the RASD.
In this Chapter we show which components communicates with each other to enforce the fulfillment of the requirements.

4.1 Requirements and system interactions

A small description of the interactions is here to show how the communication should be performed.

- R1) Authorities' location must be known by the system when they are in service : Authority Position Servlet gets data about authorities' location and through User Manager, the application sends data to the server everytime the authority moves from the previous locationn of at least more than 200 meters.

- R2) Data relative to the violation sent by the user must be clear : Application checks if at least one photo contains a licence plate clearly visible and recognizable by a Licence Plate Recognizing Algorithm, other usefull information like position are collected from mobile phone's system, if not possible the user can insert position data but the entered position validity will be checked. Time is added server side. Time is added server side to avoid time ambiguity(client devices can have different timezones selected).

- R3) The right authorities are notified about violations : Notification Manager gets Authority position from database. The position is updated by User Manager which communicates with the DataBase Connection package trough DataAccess Facade.

- R4) Authority must be able to provide the system how the assignment finished: resolved, no intervention needed when arrived, false report: Application after an authority accepted an assignment takes him/her to a screen where the assignment can be terminated. This Screen allows user to communicate with the Assignment Servlet which notifies the Report Manager.

- R5) The system must make data available when asked: Data Access Facade allows all manager classes in the server package to access data which can be showed to users. User may query data making calls to the servlets

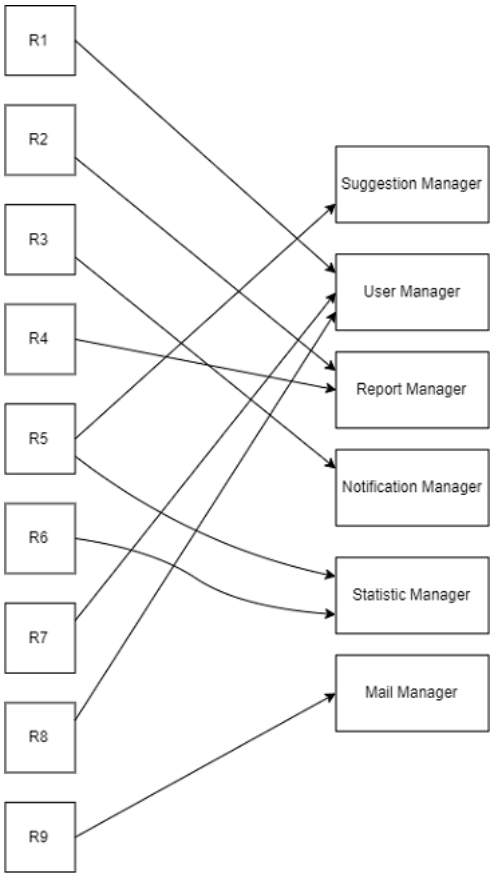
- R6)Data and statistics are always updated when an event happens: In Database Connection package Data Collector is responsible for updating data about violations in the database but also to combine data from Safestreets database and municipalities' databases to build statistics

- R7) System Manager must fill correctly the form with Municipality's data : web app allows user to insert all the needed data and doesn't allow to send data if all the needed data are not correctly inserted. For further security also Authority and municipality registration Servlet checks if all needed data are inserted.

- R8) A visitor must be able to begin sign up process in the SafeStreets App: when a visitor accesses to the SafeStreets mobile app the application shows him the Login page which contains the form to autenticate and the link to Sign upform and sends the data to the User Maanager.

- R9) When the creation is successful the system must notify the Visitor : After inserting data of the user in the database the system sends an email, containing a corfimation message , to the user email through the Mail Manager.

4.2 Requirement Mapping with Server Managers



5 Implementation, Integration and Test Plan

The System is divide in varioys subsystems:

- Mobile App
- Web Application
- Web Server
- Application Server
- DataBase Connection
- DataBase Server
- External Systems:Google Maps,External DataBases

The subsystems not external will be implemented and tested. They will also be integrated together and also with external systems. Since the Web Server provides user only static data (HTML,CSS,Javascript) and is deployed to a different device than the web Application this component can be implemented and tested in any moment during the developement but the integration must be done when the full application is implemented. Given our design choice of having a multiple servlet server which communicates with DataBase through a facade our implementation must have as a starting point the implementation of the DataBase Server and the connection with it.

5.1 DataBase Server and Connection

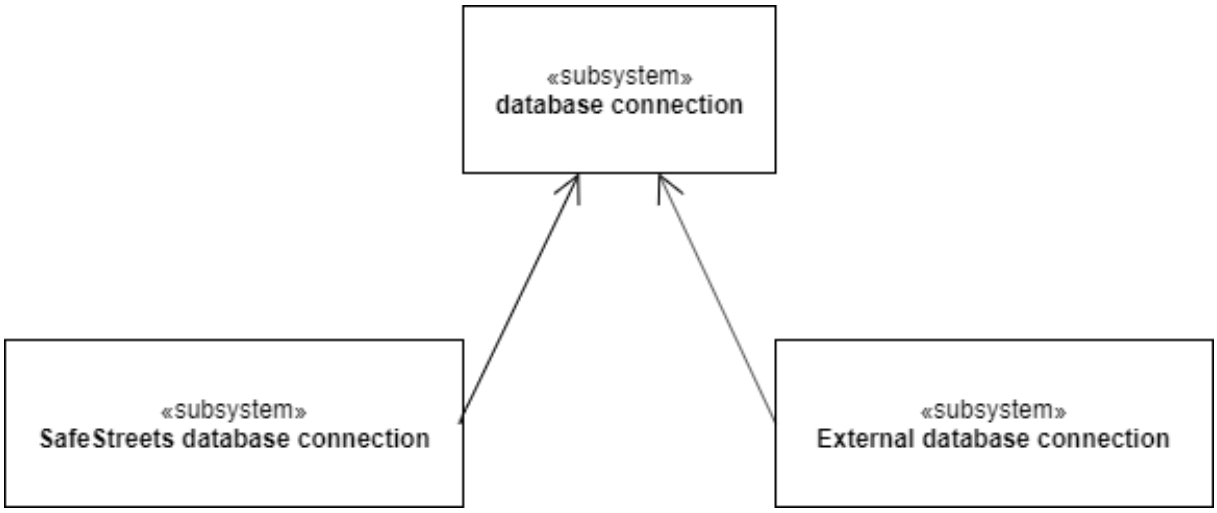


Figure 18: Database Server and Connection Integration

This phase is really important so several test will be run to check the correct functionining of the connection and the functions for data access needed by the system. In this phase also the abstract classes for the connection to external DataBases will be implemented and tested with a dummy DataBase to test that the design choice for external DataBase works correctly. Then the DataBase connnection is implemented and integrated with the DataBase Server and the External DataBase connection subsystems. The testing phase must cover as much cases as possible and different test approaches must be used to test the functionalities provided by DataBase Connection subsytem. After this initial phase the Application Server must be implemented.

5.2 Web Application

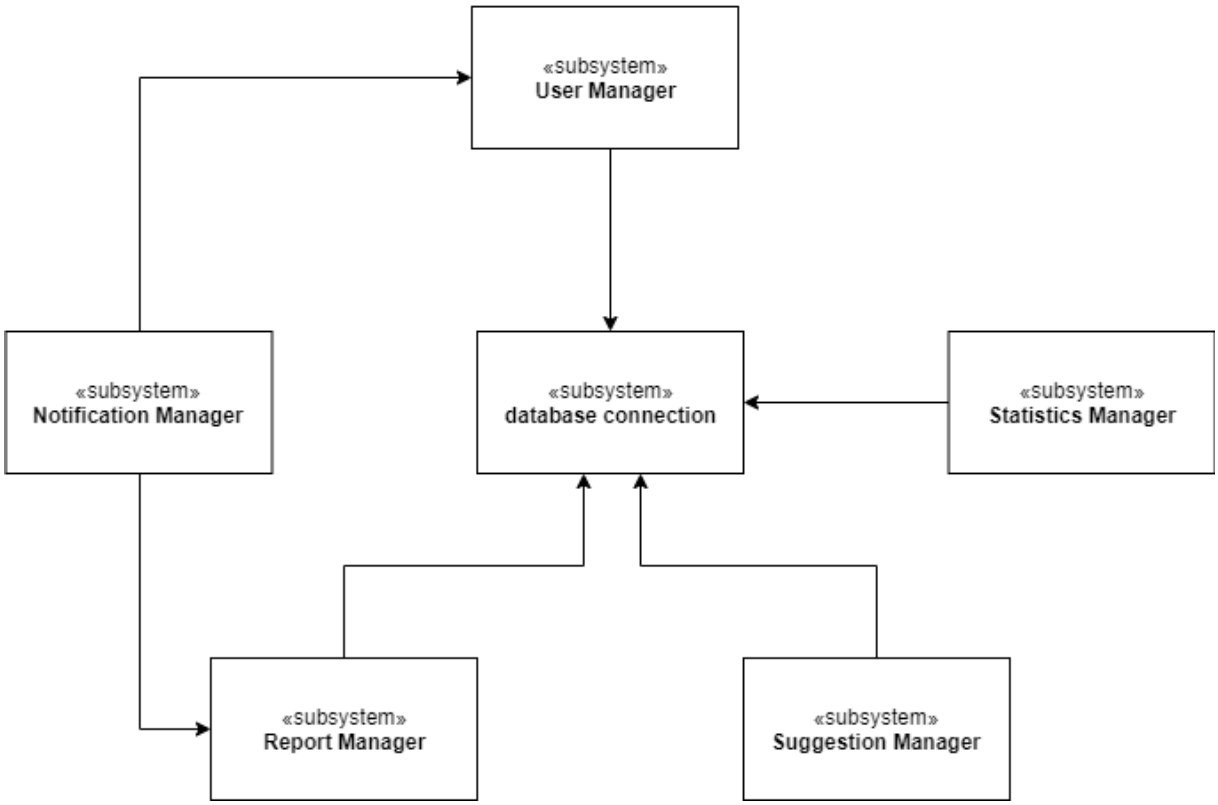


Figure 19: Servlet Integration

The implementation and testing can be perfomed in parallel for all the managers except for the notification manager which requires the implementation of the report manager and of the user manager. All theese components must be tested using test stubs to access and test functionalities of the managers covering all of them and using coverage tests to check if all the checks done on data and all possible kind of issues (I.e. missing DataBase, null values, exceptions) are handled and there are no controls which aren't reachable for any kind of input. The components are then integrated with the DataBase Connection subsystem.

5.3 Mobile App and Web Application

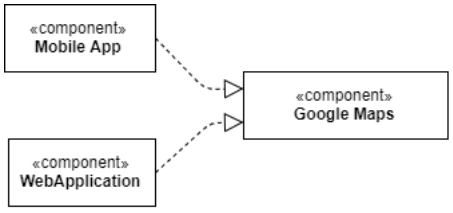


Figure 20: Google Maps Integration

In parallel to the implementation of Application Server the development of the WebApplication and Mobile App can be carried on.

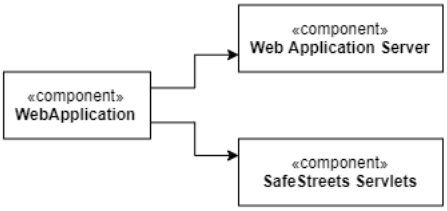


Figure 21: Web Application Integration

After the implementation both needs to be integrated with APIs provided by Google Maps and when Application Server developement will be complete they will be integrated and tested together.Web Application also needs to be integrated and tested with Web Server.

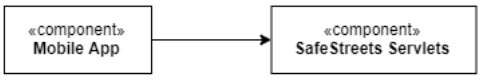


Figure 22: Mobile Applicaiton Integration

5.4 Main feature test plan after all components are integrated

Once all the systems are integrated an additional testing phase will be devoted to check the possible interaction of users with the system. For the main functionalities and interactions in the mobile application testing we will use some flowcharts and do coverage testing over them and check that no unexpected results occures with different values when citizens make reports and when authorities accepts and terminate assignments.

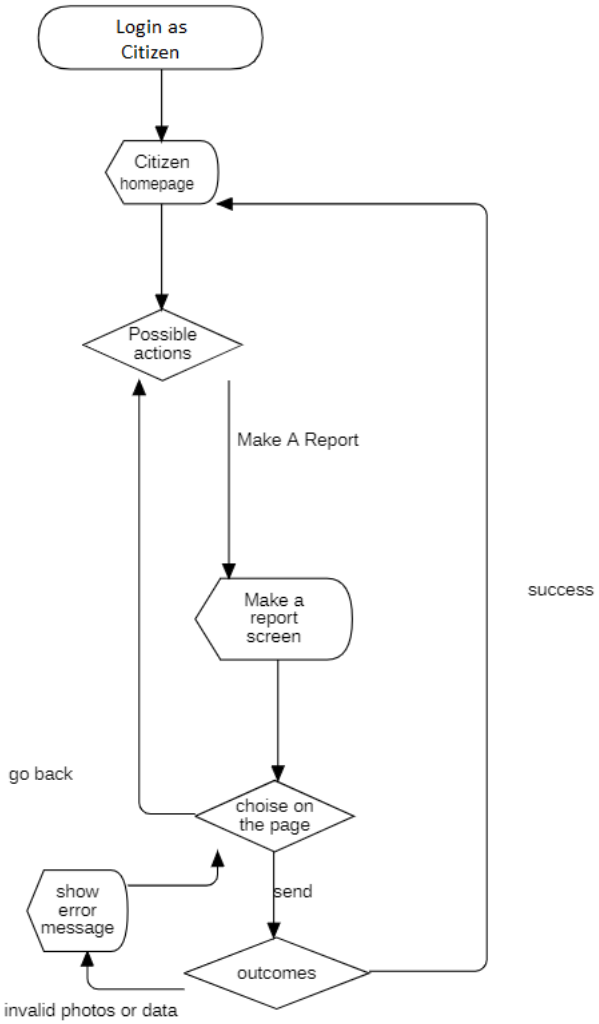


Figure 23: FlowChart: Citizen main features testing

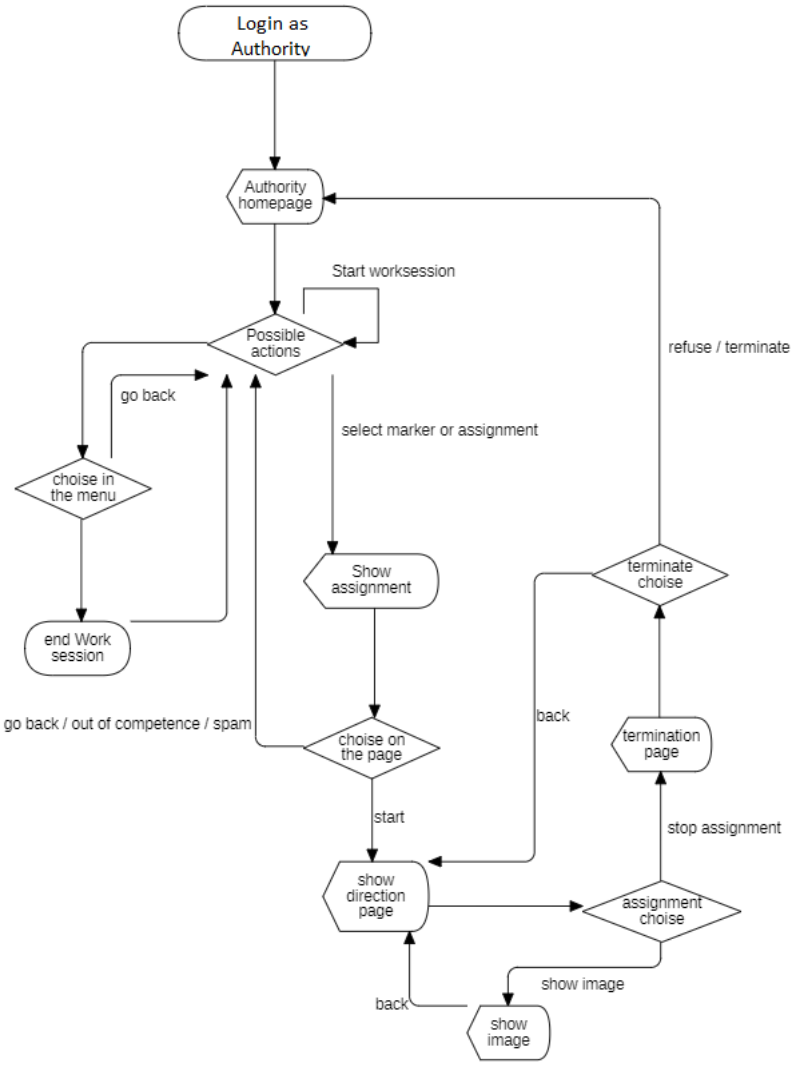


Figure 24: FlowChart: Authority main features testing

6 Effort Spent

Pietro Maldini

Section	Effort
Introduction	4
Architectural Design	30
User Interface Design	2
Requirements Traceability	4
Implementation, Integration and Test Plan	5
Total	45

Angelo Paone

Section	Effort
Introduction	3.5
Architectural Design	28
User Interface Design	2
Requirements Traceability	3
Implementation, Integration and Test Plan	4
Total	40.5

7 Appendix

7.1 Used Softwares

- UML Modeling Tools: StarUML, Draw.io
- Document Production: TeXworks
- Collaboration Environment :GitHub.com