COmmunity-Based Organized Littering

PRIN: PROGETTI DI RICERCA DI RILEVANTE INTERESSE NAZIONALE

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Software Requirements Specification

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Glossary, acronyms & abbreviations

Item	Description
COBOL	COmmunity-Based Organized Littering
CRUD	Create, Read, Update, Delete

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1 Introduction

This document specifies the requirements allocated to the software to be developed in the context of the COBOL (COmmunity-Based Organized Littering) project. The project focuses on illegal dumping and addresses the automated localization and identification of abandoned littering and of managing its proper disposal in an integrated, and flexible way. The COBOL project will deliver key novel technical solutions that can promisingly change the level of practicality of participatory approaches for littering management. In order to engage the citizens in the waste removal process, citizens will be rewarded for both reporting and removing waste, with the latter activity being rewarded the most. Further, citizens will be rewarded for confirming or disproving waste removal actions taken by other actors. Administrations will also compete in terms of their ability to keep areas clean, based on citizens' reports.

In particular, it will deliver lightweight littering reporting solutions that will enable devices to report littering transparently (e.g., automatically detecting and reporting the littering present in a selfie taken by someone), in addition to letting citizens to report littering explicitly. It will deliver comprehensive engagement models that involve all the stakeholders playing a role in the littering disposal process. It will collect and process data at the level of multiple communities exploiting federated learning techniques, delivering unprecedented littering prediction and detection capabilities that can be exploited also by small rural communities that could not otherwise generate enough data to train effective models. It will deliver a model-driven self-adaptive solution that can be flexibly adapted to the various contexts and can deal with unexpected events to guide citizens and authorities effectively in the waste disposal process. Pilots with two municipalities will demonstrate the effectiveness of the COBOL solution.

The initial version of this document contains:

(i) the actor descriptions;

(ii) the list of functional and nonfunctional requirements;

(iii) the use case diagrams. The use cases describe the functionalities of the system from the viewpoint of an actor. It is a technique for capturing, modelling, and specifying the requirements of a system;

(iv) the use case descriptions;

(v) the requirements and use case matrix;

(iv) the behavioral diagrams for the main scenarios.

2 Requirements specification

This chapter aims to provide the requirements behind the COBOL platform.

2.1 Definitions

Actors

- Guest: user not registered
- Registered user: the basic entity who interacts with the system by means of the common use cases (shared with all the other actors). The user has a registered account.
- Citizen: any ordinary person who contributes to the COBOL platform once registered, whether by entering data into the system (for instance, reporting geolocalized pictures) or consuming data from the system (i.e. information about the process to be followed to dispose of the waste).
- Admin: technical staff responsible for the system with all privileges.
- Government worker: public administrators or policy-makers that will use the system reports to take actions such as, keep areas clean or demonstrate the impact of littering management.
- Garbage collector agent: agencies or specialised companies involved in collecting the litter.

Requirements types

- CORE: core requirement **mandatory** to achieve the minimum project's objective (that is, the capability to report and collect littering). These requirements have to be fulfilled as soon as possible.
- ADV: advanced requirement that **contributes** to achieving the project's objectives by a stronger degree (e.g., adding gamification, learning, etc.)
- OPT: nice to have requirements, **not mandatory**
- RES: requirements related to **research tasks**. They are not mandatory, nor will they be released as part of the final system, but they will be experimented within controlled studies/PoCs.

2.2 Functional requirements

ID	Description	Types
Sign up		
REG-1	As a Guest, I want to register on the platform, so that I can create a new account for this system.	CORE
REG-2	As a Guest, I want to confirm my registration, so that I receive an email to confirm my registration on the system.	ADV
Login		
LOG-1	As a Registered user, I want to log in with the existing credentials, so that I receive the correct access privileges.	CORE
LOG-2	As a Registered user, I want to update my personal data, so that I can change my personal information (personal data, password, except user name).	ADV
LOG-3	As a Registered user, I want to be able to recover my password, so that a new password is sent to the email I have registered.	ADV
LOG-4	As a Registered user, I want to be able to logout of the system.	ADV
LOG-5	As a Citizen, I want to request my account deactivation	CORE
Management		
MNG-1	As an Admin, I want at least an Admin to approve a request for a new Admin, so that no user can become Admin without explicit approval.	ADV
MNG-2	As an Admin, I want to manage the Registered users, so that I will be able to perform the CRUD operations on Registered users.	CORE
MNG-3	As a Government worker, I want to access the dashboard to generate reports, so that I can monitor the information related to littering (e.g., date, time, type of litter, location, hot areas, and user info).	CORE
MNG-4	As a Government worker, I want to be automatically notified about hot areas, decide whether it is a hot area and then scale the notification to the public, so that everyone can see the notification.	CORE

MNG-5	As a Government worker, I want to assign specific agents, so that they can remove litter that requires special handling.	CORE
MNG-6	As a Government worker, I want to visualise the global and historical situation within a certain area to discover possible patterns and apply decision-making on the highlighted area.	ADV
MNG-7	As a Government worker, I want to create an (empty?) community and to let a municipality enter a community.	ADV
Reporting		
REP-1	As a Citizen, I want to report littering, so that the reporting can be either explicit (performed by the Citizen) or implicit (Citizen can enable devices to automatically report any detected waste without manual intervention).	CORE
REP-2	As a Citizen, I want to add information to the reported littering, so that I can attach geolocalized pictures of the litter.	CORE
REP-3	As a Citizen, I want to see the status of my reports, so that I may know if my report has been taken under consideration by authorities.	CORE
REP-4	As a Government worker, I want the report status to be automatically updated when the reporting involves an autonomous resolution of the Citizen.	CORE
REP-5	As a Citizen, I want to be rewarded, so that after the littering report is confirmed, I can visualise the points.	CORE
REP-6	As a Citizen, I want my devices to implicitly report littering areas, only if my authorization is granted.	CORE
REP-7	As a Registered user I want to be able to label the litter on the image, so that this labelled example can be used to train the model for waste recognition.	CORE
REP-8	As a Government worker, I want to confirm the examples labelled by the users to avoid any concept drift due to potential malicious behaviors.	ADV
REP-9	As a Citizen, I want to be notified when I am near littering that has been reported by another user so that I can confirm its presence. (This enhances confidence regarding the existence of the littering.)	ADV
Removing		

REM-1	As a Registered user, I want to report littering removal, so that I can correctly register this report on the system.	CORE
REM-2	As a Registered user, I want to attach pictures on the system, so that I can confirm a removal.	CORE
REM-3	As a Registered user, I want to request information, so that the system provides me instructions about elimination of a specific littering.	ADV
REM-4	As a Registered user, I want to visualise the hot areas, so that I can also see the littering that should be removed next to my actual localization.	CORE
REM-5	As a Registered user, I want to see the status of my removing reports, so that I may know if authorities have considered them.	CORE
REM-6	As a Government worker, I want the removing report status to be updated, so that it can be either automatically updated by the system or by me.	CORE
REM-7	As a Registered user, I want to be rewarded, so that after the removal is confirmed, I can visualise the points.	CORE
REM-8	As a Registered user, I want to confirm the waste removal actions, so that I can confirm or disprove a removal performed by other actors.	CORE
Rewarding		
REW-1	As a Registered user, I want to receive points according to my actions (reports, removal, confirmation, and so on), so that each action has a specific score, and the rewarding criteria is automatically updated or modified by the Government workers.	ADV
REW-2	As a Registered user, I want to exchange my accumulated points, so that I can choose different kinds of services, such as public transportation tickets or discounts in public taxes.	ADV
REW-3	As a Registered user, I want to access my rewards, so that I can visualise the data concerning my own contribution to the systems (n° of reports, n° of cleaning, n° of points, and so on).	ADV
REW-4	As a Government worker, I want to visualise the points according to some pre-defined KPIs elaborated on the entire city.	ADV
System Configuration		

CFG-1	As a Government worker, I want to define a littering process with model-based representation.	CORE
CFG-2	As a Government worker, I want to define the rewarding model coupled with the actions that the user can apply in the reporting and removal process.	CORE
CFG-3	As a Government worker, I want to define KPIs based on basic actions, e.g., reporting and removal of litter, or on data derived from the rewarding model.	CORE
CFG-4	As an Admin, I want to feed the system with the defined models so that the removal and the rewarding processes are transparently applied.	ADV

2.3 Non-functional requirements

ID	Description	Priority
Security		
SEC-1	Registration data must be validated.	CORE
SEC-2	Models and data must be exchanged using secure channels.	CORE
Privacy		
PRV-1	Reports should not publicly display personal user data.	ADV
PRV-2	Users' data must never be displayed to other members of the platform.	ADV
PRV-3	The implicit data collected should be anonymized on the fly, to not disclose sensitive information.	ADV
PRV-4	Implicit reporting can be limited to specific subsets of pictures.	ADV
UX		
UX-1	The system should use messages to confirm users' actions and informative messages, to give feedback to the user.	OPT
UX-2	The mobile app must use Material Design 3 implemented in Flutter.	CORE
UX-3	The system must be responsive.	ADV
UX-4	The system must show the actions and interactions the user completed in a gamified fashion.	CORE
UX-5	The system must respect accessibility standards.	OPT
UX-6	The system must be accessible.	OPT
Infrastructure		
INF-1	The Data-Processing Architecture should be decentralised, based on a containerized microservice-based architecture.	ADV
INF-2	The implementation should be open source.	ADV
INF-3	Data storage must use Firebase.	CORE

3 Use cases

3.1 Use Case diagrams

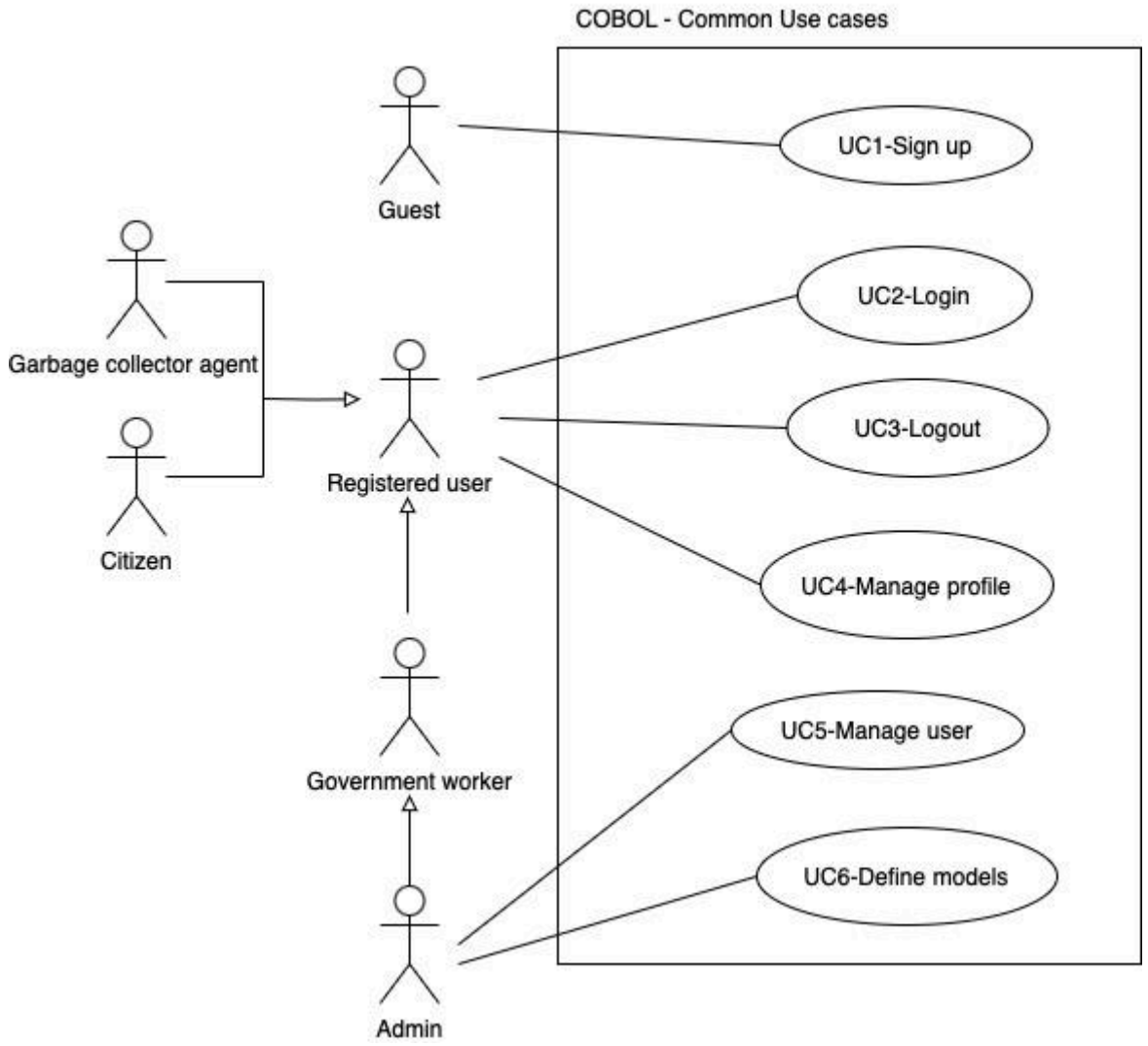


Fig.1: Generalisation between actors and use cases for actors Guest, Registered user, and Admin

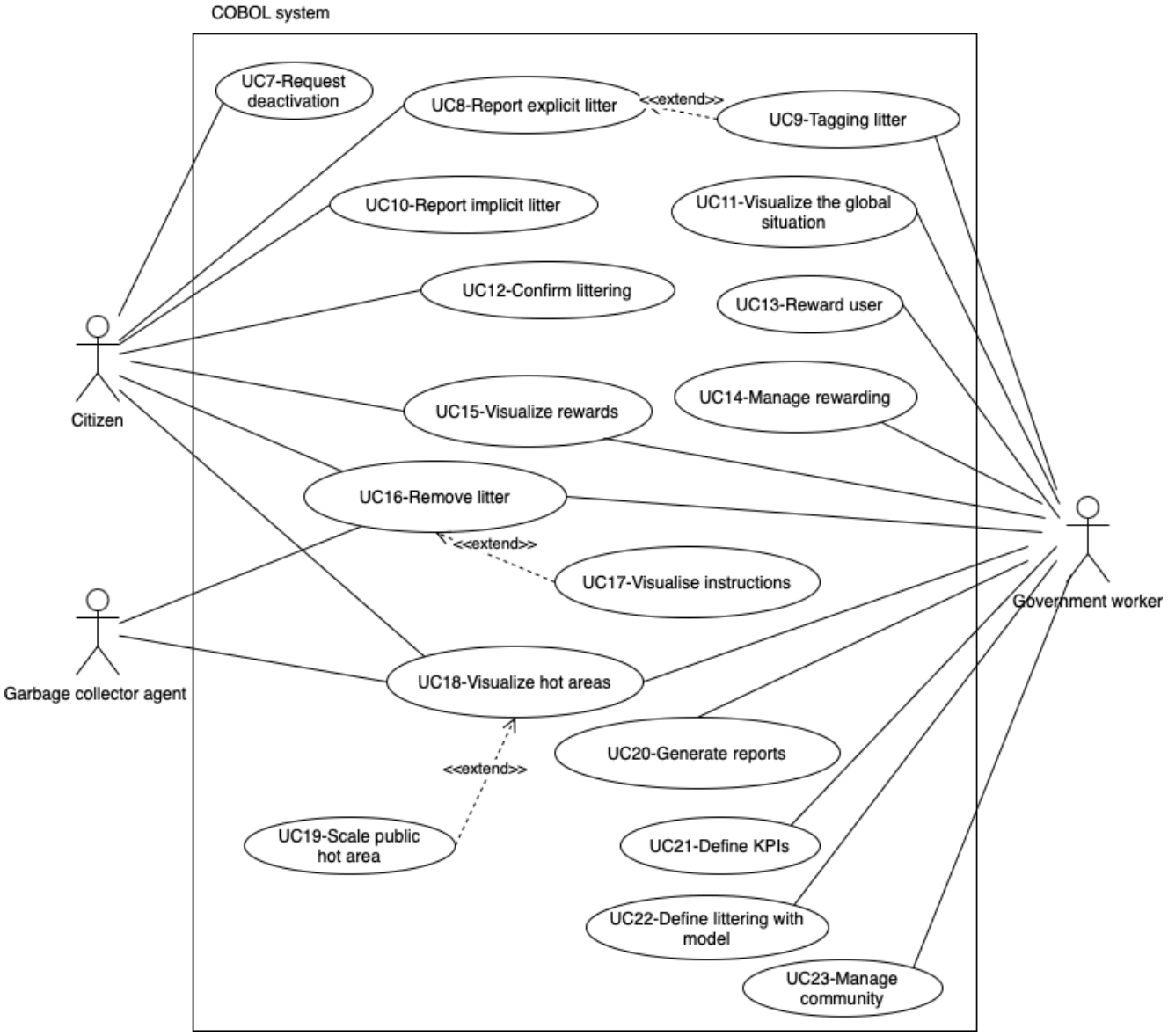


Fig.2: Use cases for actors Citizen, Government worker, and Garbage collector agent

3.2 Use case descriptions

UC1	Sign up
Purpose	Guest register in the system, in order to guarantee access to the platform
Primary actor	Guest
Precondition	The user is not already registered in the system
Success guarantee	The Guest is registered on the platform
Main success scenario	1. Guest submit the required data 2. Guest confirm the registration email 3. The system shows the Citizen is registered
Extensions	1a. Submitted data is incomplete 1a1. The system requests missing data 1a2. Guest supplies missing data 2a. Guest doesn't confirm the email 2a1. Another email is sent 2a2. Guest confirm the registration email

UC2	Login
Purpose	Login into the system with the credentials previously registered, in order to guarantee access to the platform
Primary actor	Registered user
Precondition	Registered user must have a registration
Success guarantee	The Registered user is able to access the platform according to its correct privileges
Main success scenario	1. Registered user inserts the credentials 2. The credentials are verified 3. Registered user is logged in the platform
Extensions	2a. Credentials are wrong 2a1. System asks again the credentials 2a2. Registered user supplies the credentials 2a3. Registered user is logged in the platform

UC3	Logout
Purpose	Logout the system
Primary actor	Registered user
Precondition	Registered user must be logged in the system
Success guarantee	Registered user is logged out
Main success scenario	1. Registered user chooses to logout 2. Registered user is logged out
Extensions	

UC4	Manage profile
Purpose	View or update personal data on the platform
Primary actor	Registered user
Precondition	Registered user should be logged in the system
Success guarantee	The Registered user is able to consult and update its personal data
Main success scenario	1. Registered user visualise its data 2. Registered user chooses to edit 3. Registered user make the changes 4. Changes are registered 5. The system shows the new data
Extensions	2a. Registered user doesn’t choose to edit

UC5	Manage user
Purpose	Manage (create, visualise, update, delete) the users registered on the platform
Primary actor	Admin
Precondition	User should be logged in the system
Success guarantee	The changes relating to the user are registered on the platform
Main success scenario	1. Admin chooses the desired transaction (create, visualise, edit, or delete) 2. Admin performs the necessary changes

UC5	Manage user
Purpose	Manage (create, visualise, update, delete) the users registered on the platform
	3. Changes are registered 4. The system presents the changes
Extensions	2a. Admin doesn't need perform changes

UC6	Define models
Purpose	Feed the system with the defined models so that the removal and the rewarding processes are transparently applied
Primary actor	Admin
Precondition	User should be logged in the system
Success guarantee	The models are correctly defined on the platform
Main success scenario	1. Admin chooses the desired transaction on the model (create, visualise, edit, or delete) 2. Admin performs the necessary changes 3. Changes are registered 4. The system presents the changes
Extensions	2a. Admin doesn't need perform changes

UC7	Request deactivation
Purpose	The Citizen wants to deactivate his/her system account
Primary actor	Citizen
Precondition	The Citizen is registered in the system
Success guarantee	The Citizen account is deactivated and he/she no longer has access to the platform
Main success scenario	1. Citizen submit the request 2. Citizen confirm the deactivation through email 3. The system shows the Citizen account is deactivated
Extensions	2a. Citizen doesn't confirm the email 2a1. Another email is sent 2a2. Citizen confirm the deactivation email

UC8	Report explicit litter
Purpose	Register the litter explicit report in the system, with geolocalized pictures and available information relating to quantity, kind of litter, and whatever else spare data
Primary actor	Citizen
Precondition	Citizen should be logged in the system
Success guarantee	The report is registered in the system. The Citizen profile is updated with a new report linked to the Citizen
Main success scenario	1. Citizen enters the information required by the system, like, estimated quantity, localization, date, and time 2. Citizen uploads geolocalized pictures of the littering 3. The report is registered on the system 4. The system shows the citizen the new litter report created with the initial status
Extensions	1a. Submitted data is incomplete 1a1. System requests missing data 1a2. Citizen supplies missing data 2a. Citizen doesn't submit picture 2a1. System requests missing picture 2a2. Citizen supplies missing picture

UC9	Tagging litter
Purpose	Label (apply tags) to the litter reported
Primary actor	Citizen
Precondition	UC8
Success guarantee	The litter report receives labels that is used to train the model for waste recognition
Main success scenario	1. The citizen takes the picture 2. The platform asks for tagging the picture with material included and a rough estimate of the volume 3. The citizen taps the picture and applies a category of waste, e.g., plastic, and a category of volume, e.g., small/medium/large 4. Tagged images are used to update the automatic litter detection model to be also used for implicit litter reporting
Extensions	2a. The picture is not visible 2b. The platform automatically suggests tags to accept/decline categorization of the content (of the picture)

UC10	Report implicit litter
Purpose	Register the litter report automatically in the system through the Citizen's device (e.g., smartphones, smart glasses, and tablets) with the media collected by Citizens (e.g., photos and videos)
Primary actor	Citizen (device)
Precondition	Citizen must have authorised the software use in background
Success guarantee	The implicit report is registered in the system
Main success scenario	1. Citizen device send pictures to the system stating new waste detection, together with the collected metadata 2. The implicit litter report is registered in the system 3. A notification is sent to the Citizen
Extensions	

UC11	Visualise the global situation
Purpose	Visualise on the map the global situation relating to the littering within a certain area
Primary actor	Government worker
Precondition	Government worker should be logged in the system
Success guarantee	The Government worker is capable of visualising the global littering situation according to the area, moving from one area to another of the map
Main success scenario	1. Government worker opens the map 2. Government worker chooses one area to visualise the actual situation
Extensions	

UC12	Confirm littering
Purpose	Register the litter waste report/removal actions taken by other actors, confirming or disproving the action
Primary actor	Citizen
Precondition	Citizen should be logged in the system
Success guarantee	The confirmation of waste report/removal is registered on the system

UC12	Confirm littering
Purpose	Register the litter waste report/removal actions taken by other actors, confirming or disproving the action
Main success scenario	1. Citizen send the pictures to the system to confirm the waste report/removal, together with the collected metadata 2. The confirmation of waste report/removal is registered in the system 3. The system shows the Citizen the confirmation created
Extensions	1a. Submitted data is incomplete 1a1. System requests missing data 1a2. Citizen supplies missing data

UC13	Reward user
Purpose	Reward the Registered user for both reporting and removing waste, as well as confirming or disproving waste removal actions taken by other Registered users, according to the pre-established rules
Primary actor	Government worker
Precondition	Government worker should be logged in the system
Success guarantee	The reward is registered for the Registered user
Main success scenario	1. Government worker receives the notification 2. Government worker analyses the data and confirm the reward 3. The reward is registered 4. The system confirms the rewarding 5. The Registered user receives the notification of rewarding
Extensions	2a. The analysis result is that the information is false or insufficient 2b. The points are not added

UC14	Manage rewarding
Purpose	Definition of the rewarding model coupled with the actions that the user can apply in the reporting and removal process
Primary actor	Government worker
Precondition	Government worker should be logged in the system
Success guarantee	The reward model is registered on the platform

UC14	Manage rewarding
Purpose	Definition of the rewarding model coupled with the actions that the user can apply in the reporting and removal process
Main success scenario	1. Government worker chooses the desired transaction on the model (create, visualise, edit, or delete) 2. Government worker performs the necessary changes 3. Changes are registered 4. The system presents the changes
Extensions	2a. Government worker doesn't need perform changes

UC15	Visualise rewards
Purpose	Check rewards achieved through reporting and removing waste, and confirmation of removal actions performed
Primary actor	Registered user
Precondition	Registered user should be logged in the system
Success guarantee	The Registered user can consult its rewards
Main success scenario	1. Registered user opens the rewards functionality 2. Registered user chooses the reward to visualise the actual points
Extensions	

UC16	Remove litter
Purpose	Register the own rubbish removal action
Primary actor	Registered user
Precondition	Registered user should be logged in the system
Success guarantee	The waste removal is registered on the system
Main success scenario	1. Registered user enters the information required by the system, like, estimated quantity, localization, date, and time 2. The waste removal is registered on the system 3. The system shows to the Registered user the removal was correctly created
Extensions	1a Registered user uploads geolocalized pictures

UC17	Visualise instructions
Purpose	Consult the instructions of a specific kind of garbage, containing: (a) the nature of the waste, (b) the process that should be followed to remove and/or dispose the waste, and (c) the contacts to reach the organisations that can dispose the specifically detected waste, when it could not be simply removed
Primary actor	Registered user
Precondition	UC16
Success guarantee	The instructions are available to the Registered user
Main success scenario	1. Registered user selects to see the disposal instructions 2. Registered user picks the type of litter to dispose
Extensions	2a. The Registered user doesn't find the disposal instructions for the type of litter 2a1. The Registered user contacts the public administration

UC18	Visualise hot areas
Purpose	View suggested hot areas that require careful monitoring, visualise data, notifications, and any other relevant information related to these areas of interest
Primary actor	Registered user
Precondition	Registered user should be logged in the system
Success guarantee	The Registered user is able to view the hot areas, that need particular attention
Main success scenario	1. Registered user opens the map 2. Registered user chooses to visualise the actual situation of areas that demand more attention
Extensions	

UC19	Scale public hot area
Purpose	Once notified about hot areas, the Government worker can decide whether it is a hot area and then scale the notification to the public
Primary actor	Government worker

UC19	Scale public hot area
Purpose	Once notified about hot areas, the Government worker can decide whether it is a hot area and then scale the notification to the public
Precondition	UC18
Success guarantee	The Registered user is able to view the hot areas, that need particular attention
Main success scenario	1. Government worker analysis the notifications and dashboards about hot areas 2. Government worker understands that the actual situation of some areas (hot areas) demand more attention 3. Government worker scale the not areas and all Registered users can visualise the hot areas
Extensions	2a. Government worker decides that the notification is not a hot area

UC20	Generate reports
Purpose	Generate, visualise, and analyse the reports retrieved using the dashboard templates
Primary actor	Government worker
Precondition	Government worker should be logged in the system
Success guarantee	The Government worker can generate reports according to the dashboards, using the data registered on the platform by the Registered users
Main success scenario	1. Government worker selects generate reports function 2. Government worker choose the kind of report he wants to generate 3. Government worker choose the data to appear on the report using the dashboard 4. The report is generated 5. The Government worker visualises the report generated
Extensions	

UC21	Define KPIs
Purpose	Definition of the KPIs based on basic actions, such as reporting and removal of litter, or on data retrieved from the rewarding model
Primary actor	Government worker

UC21	Define KPIs
Purpose	Definition of the KPIs based on basic actions, such as reporting and removal of litter, or on data retrieved from the rewarding model
Precondition	Government worker should be logged in the system
Success guarantee	The KPIs are registered on the platform
Main success scenario	1. Government worker chooses the desired transaction on the KPIs (create, visualise, edit, or delete) 2. Government worker performs the necessary changes 3. Changes are registered 4. The system presents the changes
Extensions	2a. Government worker doesn't need perform changes

UC22	Define littering with model
Purpose	Definition of the littering process with model-based representation
Primary actor	Government worker
Precondition	Government worker should be logged in the system
Success guarantee	The model is registered on the platform
Main success scenario	1. Government worker chooses the desired transaction on the model (create, visualise, edit, or delete) 2. Government worker performs the necessary changes 3. Changes are registered 4. The system presents the changes
Extensions	2a. Government worker doesn't need perform changes

UC23	Manage community
Purpose	Create an (empty?) community and to let a municipality enter a community.
Primary actor	Government worker
Precondition	Government worker should be logged in the system
Success guarantee	The community is registered on the platform

UC23	Manage community
Purpose	Create an (empty?) community and to let a municipality enter a community.
Main success scenario	1. Government worker chooses the desired transaction on the community (create, visualise, edit, or delete) 2. Government worker performs the necessary data 3. Data is registered 4. The system presents the updates
Extensions	2a. Government worker doesn’t need perform updates

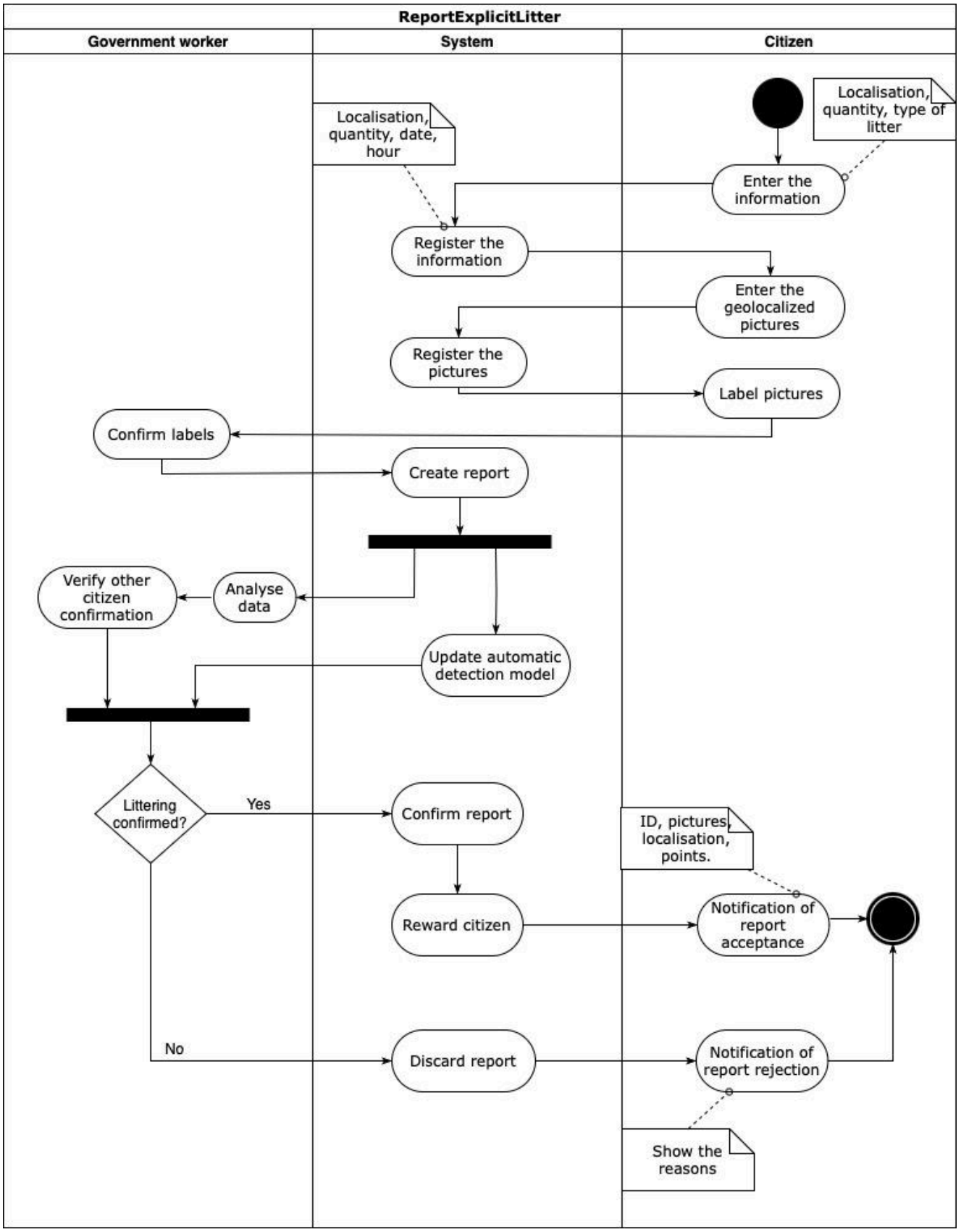
4 Requirements and use cases matrix

	UC1	UC2	UC3	UC4	UC5	UC6	UC7	UC8	UC9	UC10	UC11	UC12	UC13	UC14	UC15	UC16	UC17	UC18	UC19	UC20	UC21	UC22	UC23
REG-1	X																						
REG-2	X																						
LOG-1		X																					
LOG-2				X																			
LOG-3		X																					
LOG-4			X																				
LOG-5							X																
MNG-1					X																		
MNG-2					X																		
MNG-3																		X		X			
MNG-4																		X	X				
MNG-5																X							
MNG-6											X												
MNG-7																							X
REP-1								X		X													
REP-2								X															
REP-3								X		X													
REP-4								X		X													
REP-5								X		X			X		X								
REP-6										X													
REP-7									X														
REP-8									X														
REP-9												X											
REM-1																X							
REM-2																X							
REM-3																	X						
REM-4																		X					
REM-5															X	X							
REM-6																X							
REM-7													X		X	X							
REM-8												X											
REW-1													X										
REW-2													X										
REW-3															X								
REW-4															X								
CFG-1																						X	

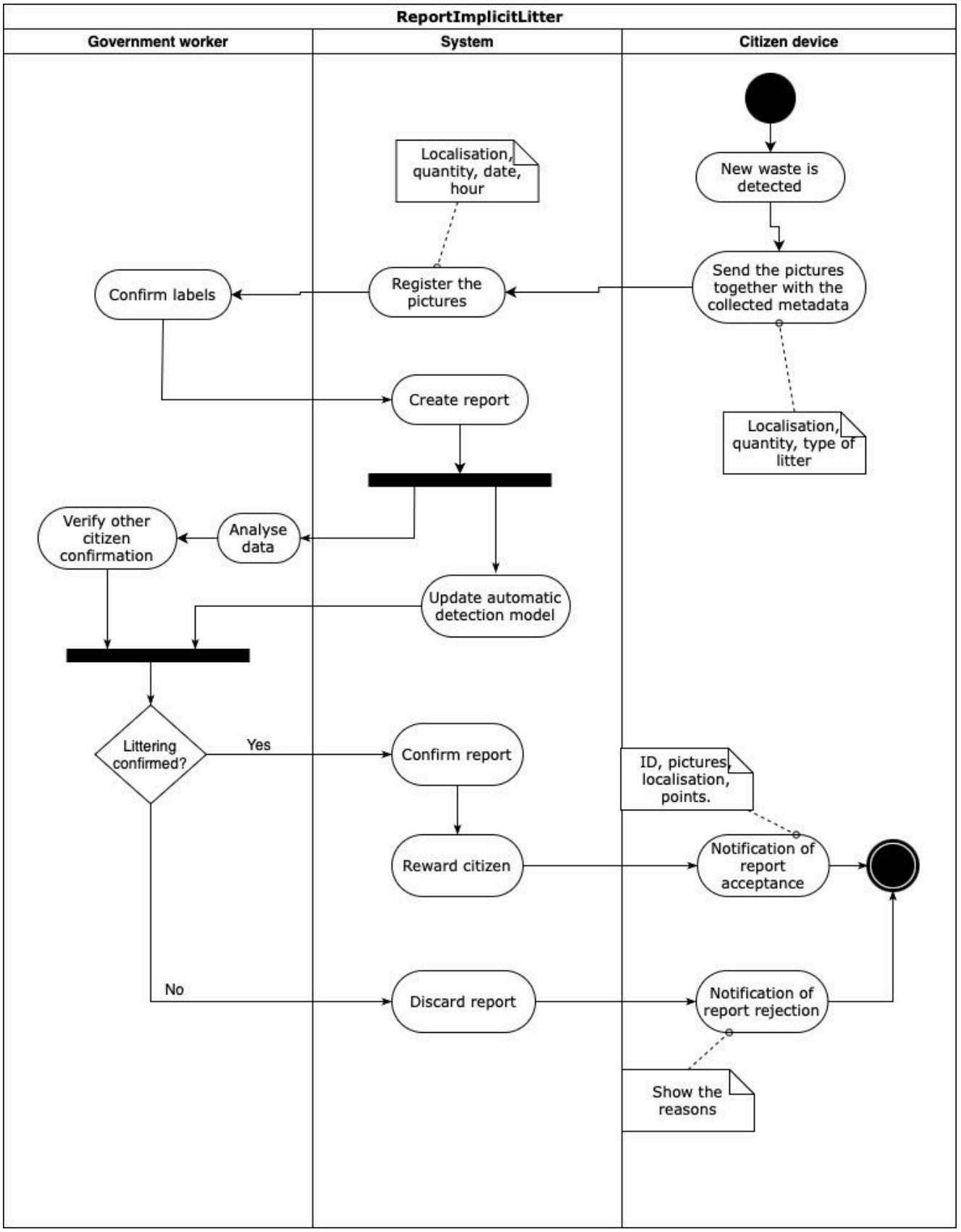
CFG-2														X								
CFG-3																					X	
CFG-4						X								X								
SEC-1	X																					
SEC-2						X								X							X	
PRV-1																				X		
PRV-2															X							
PRV-3								X		X		X										
PRV-4										X												
UX-1															X				X			
UX-2																						
UX-3																						
UX-4																						
UX-5																						
UX-6																						
INF-1																						
INF-2																						
INF-3																						

5 Behavioral diagrams

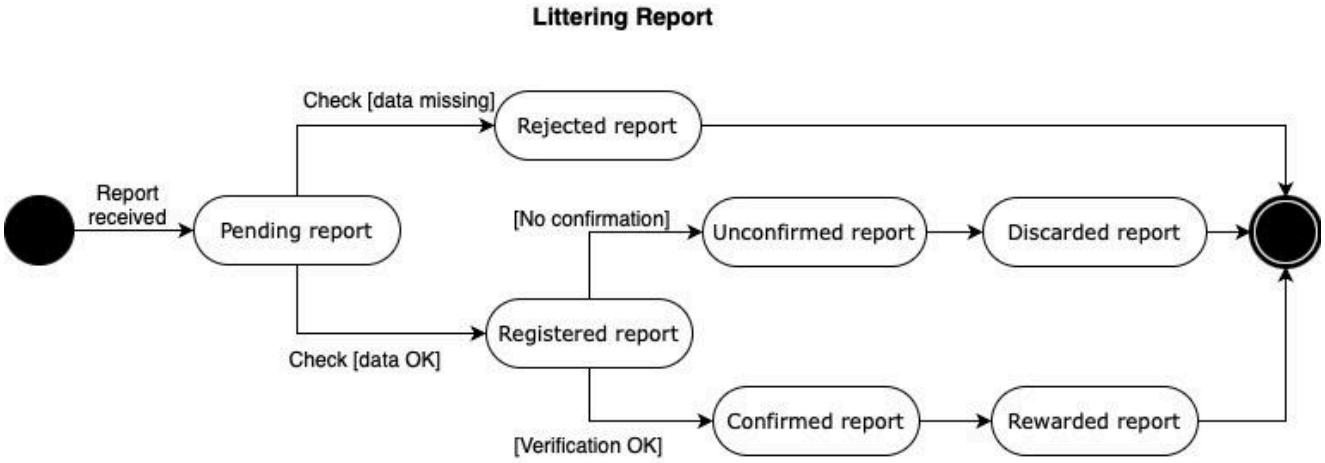
5.1 Scenario 1: Activity diagram to *Report explicit litter*



5.2 Scenario 2: Activity diagram to *Report implicit litter*



5.3 State diagram for *Report*



6 Conclusions and remarks

This document presented the first deliverable for the COBOL project, which is the document for the software specification, containing the initial defined requirements and use case diagrams, together with the use case descriptions.

7 References

Cockburn, Alistair, and Lord Cockburn. *Writing effective use cases*. Pearson Education. India, 2008.