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28.10.2019	0.1	Initial Draft	Boris Vezmar
7.11.2019	0.2	Requirements, use cases and user stories revision	Boris Vezmar, Carlo Casiglia, Dominik Kotarski, Elena Bakuleva
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16.01.2020	2.1	Minor updates	Sandra Kuzmić Elena Bakuleva



BUMPY

for the Cycling Advocacy of the Zagreb Cyclists' Union

Requirements Definition Document

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1. Introduction

1.1 Purpose of the Document

The purpose of this document is to provide an overview of what the Cyclist Advocacy project is supposed to develop, viewed from the user's perspective. In other words, this document defines customer requirements in a manner that ensures a common view of the task to be accomplished, between the development team and the customer. Additionally, this document can both guide development and serve as a quality measure of the resulting product

1.2 Document Organization

- Section 1, *Introduction*, describes the contents of this guide, used documentation during developing process etc.
- Section 2, *Background*, provides the project background information as well as a high-level description of the domain and problem
- Section 3, *Requirements*, defines all core and optional, functional and non-functional project requirements
- Section 4, *Use cases*, showing diagrams and tables for each use case
- Section 5, *User stories*, defines all user stories, high-level usage scenario descriptions

1.3 Intended Audience

- The customer
- The project's team
- Project supervisors
- All other project stakeholders

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1.4 Definition and Acronyms

1.4.1 Definitions

Keyword	Definition
Functional requirements	Product features or functions that must be implemented to enable users to accomplish their tasks. Features that form the product's functionality.
Non-functional requirements	Describe how the system should behave, as well as constraints on the system's functionality. Criteria that judges the operation of the system. Quality attributes of the system. Some non-functional requirements, such as battery optimization and code quality, are trivial and difficult to measure, so they are implied and not shown here.
Use cases	Describe all the possible interactions of different actor with the systems, which are handled through previously defined requirements.
User stories	Informal, natural language description of one or more features of a software system, usually written from the perspective of an end-user.
Collected data	Data collected bt Android during cycling, consists of Location and Motion data.
Location data	Location data collected by Android. Each GNSS point has a timestamp, latitude, longitude, elevation, speed and accuracy.
Motion data	Sensors data collected by Android. Each motion data acquisition consists of a timestamp, and three floats (one per each axis) for each sensor (accelerometer, magnetometer and gyroscope).
Raw data	A packet containing all the information collected from a single trip (ids, timestamps, GNSS data and motion data).
Trip	All the synthetic information about a trip (including path and issues).
Segment	It is the portion of space between two GNSS points. It has a length and a road quality measure.
Path	Set of contiguous segments. It represents the route followed by a cyclist during a trip.
Road Quality	It is a signed float measuring the quality of the road. It can be assigned both to segments and bumpy issues.

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Road Quality Map	It is a collection of paths and represents all the roads which have been ridden by the users. It can be plotted over a world map (e.g. OpenStreetMap).
FixMyStreet	An external platform for reporting road issues to authorities
FixMyStreet Issue	An issue pointed out by users. For example, a tree that fell over a street or a damaged semaphore.
Bumpy Issue	An issue automatically detected by the system. Only hard bumps can be identified at the moment.
Heat Map	A map plotting different level of colours (green to red) over a city map to indicate the road quality

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1.4.2 Acronyms and Abbreviations

Acronym or Abbreviation	Definition
<i>CFR</i>	Core Functional Requirement
<i>CNFR</i>	Core Non-Functional Requirement
<i>OFR</i>	Optional Functional Requirement
<i>UC</i>	Use case
<i>US</i>	User story
<i>POLIMI</i>	Politecnico di Milano (Polytechnic University of Milan)
FER	Fakultet Elektrotehnike i Računarstva (Faculty of Electrical Engineering and Computing)
UUID	Universally Unique Identifier
UI	User interface
REST	Representational State Transfer
API	Application Program Interface
ID	Identifier
DB	Database
HTTP	Hyper Text Transfer Protocol
GNSS	Global Navigation Satellite System

1.5 References

Cyclist's Union: <http://sindikاتبiciklista.hr/en/>

Fakultet elektrotehnike i računarstva: <https://www.fer.unizg.hr/en>

Politecnico di Milano: <https://www.polimi.it/en/>

FixMyStreet: <https://www.fixmystreet.org/>

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2. Background

The customer of the project is the Cyclist's Union, a volunteer association founded in 2011 and located in Zagreb, Croatia. Their goal is to promote cycling as an efficient, sustainable and healthy way of transport in order to have a clean, safe and pleasant green cities.

In accordance with their goal of getting more people to use cycling as a means of transportation, the Cyclist's Union wishes to develop a technological solution for the reporting of road conditions with the goal of monitoring and improvement. More specifically, the solution should be able to detect rough roads and road bumps, collect that information and visualize it. The basic idea is to rely on today's widespread usage of smartphones, namely Android phones, and utilize their various sensors to obtain road surface data. The data obtained by such means can then be analyzed by some algorithm in order to identify road issues like bumps and abrupt breaks, and then used to visualize and locate all potential road issues and encourage local administrations to intervene, which in turn will result in better road conditions that will incentivize people to turn to cycling.

The project team consists of four students from FER and four students from POLIMI, with one supervisor from each university.

3. Requirements

3.1 Core requirements

3.1.1 Functional requirements

ID	CFR-1
NAME	User should have unique identifier
RELATES TO	Android
DESCRIPTION	User should have a unique identifier to associate trips to specific user. Identifier should be generated when the user first opens the application.

ID	CFR-2
NAME	User identifier should be shown in application
RELATES TO	Android
DESCRIPTION	User should be able to find and retrieve identifier so it can be used to review trips on Web application

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ID	CFR-3
NAME	Active user change
RELATES TO	Web
DESCRIPTION	User can change the currently active user by entering new User Identifier.

ID	CFR-4
NAME	Active user logout
RELATES TO	Web
DESCRIPTION	User can click on Log out button and application should clear currently active user.

ID	CFR-5
NAME	Trips should have unique identifier
RELATES TO	Android
DESCRIPTION	Trip should have a unique identifier created at the start of a trip.

ID	CFR-6
NAME	There should be map with road quality and detected bumps
RELATES TO	Android, Web
DESCRIPTION	Home screen of applications should contain map displaying road conditions. Road conditions are displayed as colored lines over roads, where color indicates road condition, for example red line means that road is very poor quality while green line is for roads with excellent quality. Colors change gradually from red to green. For each detected bump there is a marker on the map. Map would also contain user location.

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ID	CFR-7
NAME	Road quality and bumps are calculated using collected data
RELATES TO	Backend
DESCRIPTION	Backend uses data collected on Android devices to calculate overall road quality and detect bumps.

ID	CFR-8
NAME	Road quality is exposed to the applications using Restful API
RELATES TO	Backend, Android, Web
DESCRIPTION	Android and web application should retrieve road quality information by simply sending GET request to server.

ID	CFR-9
NAME	Detected bumps are exposed to the applications using Restful API
RELATES TO	Backend, Android, Web
DESCRIPTION	Android and web application should retrieve detected bumps by simply sending GET request to server.

ID	CFR-10
NAME	Data collection
RELATES TO	Android
DESCRIPTION	Android application should collect Location and Motion data. Data are collected when user starts trip and finished when user ends a trip.

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ID	CFR-11
NAME	Data upload
RELATES TO	Android, Backend
DESCRIPTION	Collected data is uploaded using Restful API provided by Backend team (POST request). Data is uploaded when user ends trip. Motion data CSV file is deleted after upload.

ID	CFR-12
NAME	Data upload type
RELATES TO	Android
DESCRIPTION	There should be three types of upload <ul style="list-style-type: none"> - automatically using WiFi - automatically using WiFi or mobile data - manual upload Type of upload can be selected in application settings.

ID	CFR-13
NAME	Manual upload
RELATES TO	Android
DESCRIPTION	User can select an option which allows them to decide for each trip (after it finishes) if it should be uploaded.

ID	CFR-14
NAME	Location dependent actions
RELATES TO	Android
DESCRIPTION	Position user on map and starting trip can only be performed if location is turned on.

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ID	CFR-15
NAME	Trip start
RELATES TO	Android
DESCRIPTION	User should be able to start a trip if location is turned on.

ID	CFR-16
NAME	Trip end
RELATES TO	Android
DESCRIPTION	User should be able to end a trip.

ID	CFR-17
NAME	Trip statistics
RELATES TO	Android
DESCRIPTION	User should be able to see some basic statistics while cycling, for example: speed, distance, duration, vibration.

ID	CFR-18
NAME	Past trips overview
RELATES TO	Android, Web
DESCRIPTION	User should be able to view past trips in the form of a list or table.

ID	CFR-19
NAME	User should have previously entered User Identifier to view trips
RELATES TO	Web
DESCRIPTION	Past trips are only visible after the user enters identifier.

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ID	CFR-20
NAME	Past trip detailed overview
RELATES TO	Android, Web
DESCRIPTION	Past trips details should include additional information about a trip that were calculated on backend. This is why past trip details are only available to trips that have been previously uploaded. Trip route should be shown on a map with two markers indicating start and end point. Detected bumps are shown on the map as well.

ID	CFR-21
NAME	Past trip details calculation
RELATES TO	Backend
DESCRIPTION	Trip uploaded from Android device is processed to calculate additional information like average speed, max speed, information about elevation, vibration and detected bumps.

ID	CFR-22
NAME	Pending past trip manual update
RELATES TO	Android
DESCRIPTION	Trips that are pending upload can be manually uploaded when user initiate it.

ID	CFR-23
NAME	Past trip motion data export
RELATES TO	Android, Web
DESCRIPTION	Trip motion data can be exported in CSV file with a file name matching trip id.

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ID	CFR-24
NAME	Past trip deletion
RELATES TO	Android, Web
DESCRIPTION	User can delete trips. That trips are no longer visible to user. Both pending and uploaded trips can be deleted.

3.2.2 Non-functional requirements

ID	NCFR-1
NAME	Data collection should work even if application is in background
RELATES TO	Android
DESCRIPTION	Application should collect cycling data if sent to background, for example if user lock phone.

ID	NCFR-2
NAME	Location data format
RELATES TO	Android, Backend
DESCRIPTION	Location data consists of user and trip identifier, start and end timestamp, distance and list of GNSS points.

ID	NCFR-3
NAME	GNSS point format
RELATES TO	Android, Backend
DESCRIPTION	GNSS point contain timestamp, latitude, longitude, elevation, speed and accuracy of measurement.

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ID	NCFR-4
NAME	Location data sampling
RELATES TO	Android
DESCRIPTION	Location data should be updated every 3 seconds.

ID	NCFR-5
NAME	Motion data format
RELATES TO	Android, Backend
DESCRIPTION	Motion data are stored in CSV file. Format of file is: timestamp, accelerometer's x, y and z data, magnetometer's x, y and z data, gyroscope's x, y and z data (this is also written in file's header). If some sensor is not present in device then leave it empty.

ID	NCFR-6
NAME	Motion data sampling
RELATES TO	Android
DESCRIPTION	Motion data are updated at a frequency of 50Hz.

ID	NCFR-7
NAME	Data upload - Network connection
RELATES TO	Android
DESCRIPTION	If data upload type has connection (WiFi or Mobile data), automatically upload trip data. Otherwise they are saved to database.

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ID	NCFR-8
NAME	Manual upload is done using WiFi or Mobile data.
RELATES TO	Android
DESCRIPTION	Manual upload, since it is initiated by user, is done using either WiFi or Mobile data.

ID	NCFR-9
NAME	Storing pending trips in device's database
RELATES TO	Android
DESCRIPTION	Trips that have not yet been uploaded should be stored in device database. After upload pending trips are deleted from the database.

ID	NCFR-10
NAME	Keep screen awake when cycling
RELATES TO	Android
DESCRIPTION	Mobile screen shouldn't turn off while cycling unless user changes it in application settings.

ID	NCFR-11
NAME	Responsive design
RELATES TO	Web
DESCRIPTION	Web application should have responsive design so it can be easily accessed from tablet or mobile phone.

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ID	NCFR-12
NAME	System service on a Linux machine
RELATES TO	Backend
DESCRIPTION	The system's service needs to be deployed on a Linux machine.

ID	NCFR-13
NAME	Application language is English with support for localisation
RELATES TO	Android, Web
DESCRIPTION	The application is going to be released in english language. However it is going to be developed without hardcoded text, so it will be possible to develop other languages kits just by translating a dictionary of constants (e.g. XML or JSON file).

ID	NCFR-14
NAME	Timestamps should be in UTC format: "YYYY-MM-DDTHH:mm:ssZ"
RELATES TO	Android, Web, Backend
DESCRIPTION	Every timestamp should be in UTC format so it can be easily converted to local time.

3.2 Optional Requirements

ID	OFR-1
NAME	Completing achievements
RELATES TO	Android
DESCRIPTION	User should be able to complete achievements to make app more appealing and fun.

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ID	OFR-2
NAME	Reviewing achievements
RELATES TO	Android
DESCRIPTION	User should be able to review achievements, check when ones are already completed and which are left to complete.

ID	OFR-3
NAME	Reporting road issues
RELATES TO	Android, Web
DESCRIPTION	User should be able to report road issues using FixMyStreet module.

ID	OFR-4
NAME	Integrating FixMyStreet
RELATES TO	Backend
DESCRIPTION	The system should be integrated with the FixMyStreet platform.

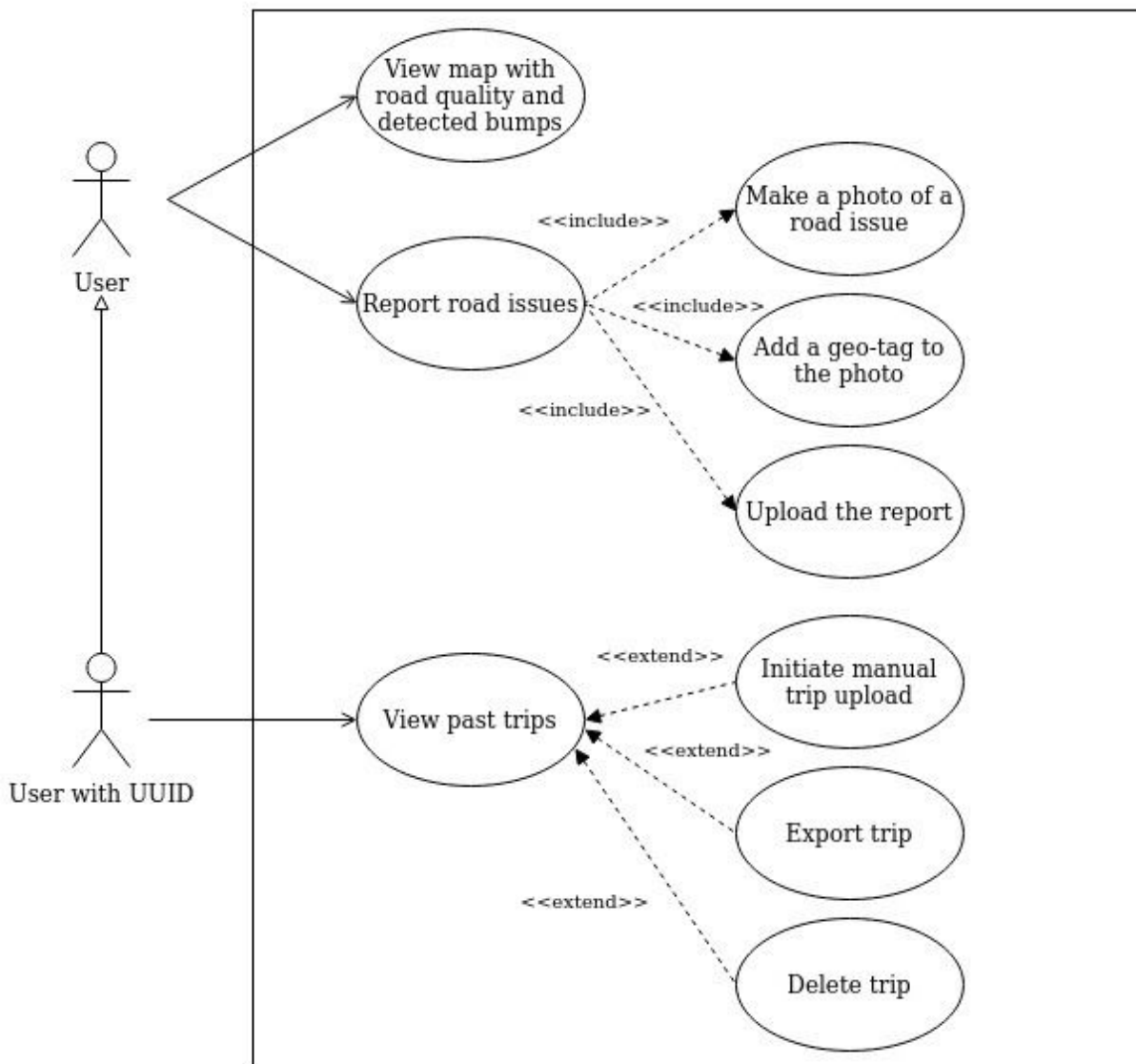
ID	OFR-5
NAME	User identifier should be displayed in short version
RELATES TO	Backend, Android, Web
DESCRIPTION	For a user to easily enter identifier, the identifier should be shorter. This should be done by matching real (longer) identifier with its short version.

4. Use cases

4.1 Use case diagrams



Use case diagram for Android application



Use case diagram for Web application

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4.2 Use case table

ID	UC-1
NAME	View the UUID
RELATED REQUIREMENTS	CFR-1, CFR-2, OFR-5
PRECONDITIONS	Application assigned unique identifier (UUID) to user.
DESCRIPTION	Using Android application user navigates to settings screen where UUID is displayed.
POSTCONDITION	UUID is displayed to user and can be used to retrieve past trips on web application.

ID	UC-2
NAME	Complete a trip
RELATED REQUIREMENTS	CFR-5, CFR-10, CFR-11, CFR-15, CFR-16, CFR-17, NCFR-1, NCFR-10
PRECONDITIONS	Application has permission to use Location and Motion sensors.
DESCRIPTION	Using Android application user selects to start a trip (UC-2.1). When trip is started, display with current trip statistics is shown (UC-2.2). If user enabled keeping screen awake, statistics will be shown during the rest of the trip (UC-2.2.2). Otherwise the screen will turn off after a few seconds (UC-2.2.1). When cycling is finished user clicks button to end a trip (UC-2.3).
POSTCONDITION	Trip is ended, collected data have started to upload.

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ID	UC-3
NAME	View map with road quality and detected bumps.
RELATED REQUIREMENTS	CFR-6, CFR-7, CFR-8, CFR-9
PRECONDITIONS	-
DESCRIPTION	Using Android or Web application user navigates to screen showing map with road quality and detected bumps.
POSTCONDITION	Map is shown, with colored lines representing road quality and markers for each detected bump.

ID	UC-4
NAME	Report road issues
RELATED REQUIREMENTS	OFR-3, OFR-4
PRECONDITIONS	-
DESCRIPTION	User opens "Report Issue" screen and submits the report.
POSTCONDITION	Report is successfully uploaded.

ID	UC-5
NAME	Check achievements
RELATED REQUIREMENTS	OFR-1, OFR-2
PRECONDITIONS	-
DESCRIPTION	Using Android application user can check completed achievements and achievements that are yet to be completed.
POSTCONDITION	List of achievements is shown with trophy icon next to completed achievements.

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ID	UC-6
NAME	View past trips
RELATED REQUIREMENTS	CFR-5, CFR-18, CFR-19, CFR-20, CFR-21, CFR-22, CFR-23, CFR-24, NCFR-8
PRECONDITIONS	User has assigned UUID.
DESCRIPTION	Using Android or Web application user can check past trips. Trips that have not yet been uploaded can be manually uploaded here, by clicking on the upload button (UC-6.1). Trips can be exported in file (UC-6.2). Trips can be deleted (UC-6.3)
POSTCONDITION	Past trips are shown. If manual upload was started, trip is uploaded and there is no upload icon anymore. If trip is exported, new file is created with collected motion data. If trip is deleted, it is not visible to user anymore.

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5. User stories

ID	US-1
RELATED USE CASES	UC-2, UC-6
STORY	As a user, I want to record cycling trip data, review and manage it later at any moment.

ID	US-2
RELATED USE CASES	UC-2.2
STORY	As a user, I want to see relevant cycling statistics during a trip, like speed, duration, distance, and vibration.

ID	US-3
RELATED USE CASES	UC-2.2.2
STORY	As a user, I want to keep my screen awake during the trip so I can see trip statistics.

ID	US-4
RELATED USE CASES	UC-3
STORY	As a user, I want to check the bumps and road quality of the streets.

ID	US-5
RELATED USE CASE	UC-6.1
STORY	As a user, I want to be able to upload trip data later if currently there is no Network connection.

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ID	US-6
RELATED USE CASE	UC-5
STORY	As a user, I want to be motivated to cycle more through a system of app awards or accomplishments.

ID	US-7
RELATED USE CASES	UC-1
STORY	As a user, I want my trips are associated with my profile so I can review it from anywhere.

ID	US-8
RELATED USE CASES	UC-4
STORY	As a user, I want to report issues so other people are aware of the problems.

ID	US-9
RELATED USE CASE	UC-6.2
STORY	As a user, I want to export trip data, including location and motion data, in a separate file, so I can present it to relevant local authorities and incentivize road repairs and improvements.

ID	US-10
RELATED USE CASE	UC-6.3
STORY	As a user, I want to be able to delete trips.

End of document