# Requirement Analysis and Specification Document
## Best Bike Paths

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# 1  Introduction

## 1.1  Purpose

In the world of cycling, it is often useful to record information about routes and track personal performance, as well as to share these experiences with others. Having access to updated data about bike pathssuch as their conditions, safety, and suitabilitycan greatly enhance both the enjoyment and safety of cyclists.

**Best Bike Paths (BBP)** was conceived in this context, with the goal of creating a digital platform where cyclists can explore, record, and share information about cycling routes. The system promotes collaboration among users, encouraging the community to contribute and maintain reliable data on the status of bike paths.

### 1.1.1  Goals

**G1 -  User Registration and Authentication:** The system shall allow users to register and authenticate themselves to access the full range of functionalities provided by the application.

**G2 -  Trip Recording and Manual Path Registration:** The system shall enable registered users to record their cycling trips, store them for activity tracking purposes, and manually insert bike path information by specifying street names and their current status.

**G3 -  Meteorological Data Integration:** The system shall enrich recorded trip data with meteorological information (including weather conditions, temperature, and wind speed) retrieved from external services, when available.

**G4 -  Automated Mobile Data Acquisition:** The system shall acquire data automatically from users' mobile devices during cycling activities, including GPS coordinates for path reconstruction and accelerometer/gyroscope data for obstacle detection (e.g., potholes).

**G5 -  User Validation of Automated Data:** The system shall require users to confirm or correct automatically acquired information before making it available to the community, ensuring data accuracy and minimizing false positives.

**G6 -  Community-Driven Path Information Publishing:** The system shall allow registered users to insert bike path information and make it publishable to the community, contributing to the shared knowledge base.

**G7 -  Universal Path Search and Map Visualization:** The system shall allow any user (registered or non-registered) to specify an origin and destination, and visualize the available bike path(s) between these two points on an interactive map.

**G8 -  Path Scoring:** The system shall compute a score for each bike path based on its current status and effectiveness in connecting origin to destination, and visualize paths to users ordered by their computed score.

**G9 -  Multi-Source Data Consolidation:** The system shall merge bike path information collected from multiple users by considering data freshness and the number of confirming reports to determine the most accurate status assessment.

## 1.2  Scope

**Best Bike Paths (BBP)** is an application designed to support cyclists in discovering, recording, and sharing information about bike paths. Through BBP, registered users can record their rides, visualize the paths on a map, and obtain performance statistics such as distance, speed, and duration. When available, the system automatically integrates meteorological informationincluding temperature, wind speed, and weather conditions.

Users can insert or update path information either manually, by specifying the streets and their conditions, or automatically, by allowing the application to collect GPS, accelerometer, and gyroscope data during a trip. This data helps identify irregularities such as potholes or rough road segments. Before being published, automatically detected issues must be validated by the user to ensure reliability.

The platform provides map-based search and visualization tools allowing any user, registered or not, to explore available routes between a chosen origin and destination.

### 1.2.1  World Phenomena

**WP1 -** A cyclist rides along a bike path

**WP2 -** A cyclist seeks to discover a new route

**WP3 -** A person recommends a starting point, destination, or place to another cyclist

**WP4 -** Changes in weather conditions

**WP5 -** Physical deterioration of a bike path

**WP6 -** Appearance of an obstacle along a bike path

**WP7 -** Irregularities or bumps on the road surface cause vibrations on the cyclists device

**WP8 -** A user enables localization services

### 1.2.2  World-controlled Shared Phenomena

**SP1 -** A user registers or logs into the system by entering their credentials

**SP2 -** A cyclist records a bike route by manually entering route information (e.g. street names, status, obstacles ecc.)

**SP3 -** A cyclist edits a previously saved route

**SP4 -** A cyclist starts or stops the automatic tracking mode of a ride

**SP5 -** A cyclist confirms or corrects the information acquired by the automatic tracking system

**SP6 -** A cyclist decides to publish a personal recorded route

**SP7 -** A user searches for available routes between two locations

**SP8 -** A user views the information of a specific bike route

### 1.2.3  Machine-controlled Shared Phenomena

**SP9 -** The system adds supplementary data after a route is submitted (such as total distance covered, average speed, and other performance metrics)

**SP10 -** The system contacts an external weather service

**SP11 -** The system enriches a route by adding weather data retrieved from the external weather service

**SP12 -** The system collects data from the cyclists device sensors and creates a new trip

**SP13 -** The system detects irregularities along the route and presents them to the user at the end of the trip

**SP14 -** The system assigns a score to each route based on its condition and its effectiveness in connecting the selected origin and destination

**SP15 -** The system displays the available routes on a map between two points based on their score

**SP16 -** The system merges data acquired from multiple users for the same route, based on data freshness and the number of consistent confirmations

## 1.3  Definitions

## 1.4  Acronyms

- BBP: Best Bike Paths

- UML: Unified Modeling Language

## 1.5  Abbreviations

- Gn: Goal number n

- Rn: Requirement number n

- Dn: Domain assumption number n

- WPn: World phenomena number n

- SPn: Shared phenomena number n

- UC: Use case

## 1.6  Revision History

## 1.7  Reference Documents

## 1.8  Document Structure

- **Introduction**: Presents the purpose and goals of the document, the context in which the system operates, and a brief overview of the software to be developed.

- **Overall Description**: Provides a high-level view of the system, describing its main functions, the type of users involved, and the constraints under which it operates.

- **Specified Requirements**: Details the functional and non-functional requirements of the system. This section includes use cases, scenarios, and detailed interactions between users and the system, as well as performance, reliability, and usability requirements.

- **Formal Analysis**: Describes the formal modeling of the systems behavior through conceptual tools such as UML diagrams, Alloy models, or other formal methods. This section ensures the consistency and correctness of the requirements.

- **Effort Spent**:Summarizes the amount of work dedicated to each phase of the project, specifying the contribution of each team member and the approximate time spent on the various activities.

- **Software Used**: Software used to develop the document.

# 2 Overall Description

## 2.1 Scenarios

**Cyclist registers on BPP**: The cyclist Bob accesses BPP platform for the first time and decides to create an account. He opens the registration form and enters the required information, including his email address, password, and general personal details (such as name, surname, and date of birth). Once the registration is completed successfully, Bob gains access to the main dashboard of the platform, where he can start exploring available routes or contribute by creating his own.

**Cyclist manually uploads a route**: After completing a cycling trip, Bob logs into BPP and clicks on the Create New Route button on the homepage. He manually enters the route details including street names, path status, and possible obstacles and can optionally add comments or short descriptions to help other cyclists. Before saving, Bob selects whether to make the route public (visible to all users) or private (accessible only to him). Once submitted, the route is stored in the system and appears in Bobs personal list of recorded paths.

**Cyclist uploads a route using automatic mode**: After enabling the location services on his device and activating the automatic tracking mode from his BPP profile settings, Bob goes for a bike ride while carrying his mobile device. During the ride, BPP automatically records the route, collecting data such as path segments, distance, and detected obstacles. Once the trip is completed, Bob accesses the platform to review the automatically generated route. He can confirm or edit the route details, verify the accuracy of the detected obstacles, and decide whether to make the route public or keep it private. Finally, he clicks the Save Route button to store the finalized version in his personal collection.

# 3 Specific Requirements

# 4 Formal Analysis using Alloy

# 5 Effort Spent