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< Project name >

Functionality specification

The Public Transportation Management System (PTMS)

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Version history

Version	Date	Author	Comment

Document certification

Name	Role	Company	Date	Signature

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Content

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Introduction

+ This functionality specification defines the requirements of the Public Transportation Management System (PTMS) announced by the State of Arstotzka, The document is based on the official project theme and follows the provided functionality specification template. Its purpose is to describe the system behaviour, user roles, assumptions and requirements in a clear and structured manner so it can serve as a contractual and implementation reference.
+ The PTMS aims to streamline public transportation operations, improve passenger experience and provide transit operators with efficient management and analytical tools.
+ Both applications need to have a response time less than 500ms. Mobile application needs to be displayed in English, German, Italian and French, while web application needs to be displayed in English and German. Communication between NFC readers and server needs to be encrypted.

Scope of the project

- what **will be implemented**

+ a web and mobile application that will be used by passengers and transit operators.
+ an IoT application embedded devices with NFC readers that are used for registering passengers when they are entering vehicles.
+ Passengers can also track the position of vehicles (bus/trams) in real time. They can also report different unusual activities.
+ transit operators manage the public transport routes in the city, adding and modifying the lines and their stops.
+ notifications about certain extraordinary traffic conditions

- what is **not the part of the project**

+ physical installation and maintenance of vehicles, stations or NFC hardware
+ payment processing, ticket pricing or financial settlement systems.
+ Long-term data warehousing or external analytics platforms beyond basic statistics

Concepts

+ **PTMS - Public Transportation Management System -** an integrated information system that supports public transport operations, passenger services and data analysis through web, mobile and IoT components.
+ **IoT - Internet of Things** - a network of embedded devices installed in public transport vehicles. In PTMS, IoT devices are equipped with NFC readers and network connectivity, enabling real-time communication with backend services and secure registration of passenger entry and exit events.
+ **Vehicle -** a public transport unit (bus or tram) equipped with IoT, NFC device.
+ **Station/Stop -** a physical location where passengers enter or exit public transport vehicles.
+ **NFC Registration** - a short-range wireless communication process that allows passengers to register boarding and alighting events using their mobile devices in interaction with IoT NFC readers.

Role description

+ **Passenger** - End user of the mobile application who consumes transit services, tracks vehicles and registers trips.
+ **Transit operator -** Authorized staff using the web application to manage transport routes in the city, stops and notifications, and to view statistics (amount of people using specific lines).They are adding and modifying the lines and their stops. They are also responsible for posting notifications about certain extraordinary traffic conditions.

+ **System administrator** – Technical role responsible for configuration, user management, and system monitoring.
+ **IoT device** – Embedded system with NFC reader responsible for detecting passenger registration events.

Assumptions and dependencies

+ All vehicles are equipped with functioning NFC IoT devices.
+ Passengers own NFC – capable smartphones.
+ Continuous internet connectivity is available for mobile, web and IoT components.
+ Map and geolocation services are provided by third-party providers.
+ Backend infrastructure is horizontally scalable to meet performance requirements.
+ Maps are up to date

List of requirements

Requirements related to functionality

<User registration and authentication 1>

The system shall allow passengers and transit operators to securely register and authenticate using role-based access control. Passengers authenticate through the mobile application, while operators authenticate through the web application.

<Real-time schedule visualization 2>

Passengers shall be able to view real-time schedules for selected stations, including arrival times and service disruptions, updated dynamically based on vehicle locations.

< Vehicle tracking 3>

The system shall display real-time positions of buses and trams on an interactive map within the mobile application.

<NFC-based passenger registration 4>

The system shall enable passengers to register entry and exit from vehicles using NFC communication between mobile devices and IoT readers.

< Route, stop, and service management 5>

The system shall allow transit operators to manage routes, lines, stops, and publish service notifications through the web application.

<Passenger reporting and statistics 6>

The system shall allow passengers to report unusual activities and provide operators with aggregated passenger usage statistics.

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Requirements related to characteristics

The non-functional requirements define the main quality constraints of the PTMS system.

- **Performance:** The system shall respond to user requests within 500 ms.
- **Security:** All communication between applications, IoT devices, and backend services shall be encrypted.
- **Availability:** The system shall ensure high availability for daily public transport operations.
- **Scalability:** The system shall support growth in number of users, vehicles, and transactions.
- **Usability:** The system shall provide intuitive and multilingual user interfaces.

The non-functional requirements define quality attributes and constraints that the PTMS system must satisfy.

- **Performance: T**he system shall respond to all user requests within 500 ms under normal operating conditions.
- **Security:** All communication between mobile applications, web applications, IoT devices, and backend services shall be encrypted using industry-standard security protocols.
- **Availability:** The system shall achieve a minimum availability of 99.5% on a monthly basis.
- **Scalability:** The system shall support an increasing number of users, vehicles, and transactions without performance degradation.
- **Usability:** The system shall provide intuitive and accessible user interfaces compliant with modern UX standards.
- **Maintainability:** The system shall be modular, well-documented, and designed to support efficient maintenance and future extensions.
- **Performance:** All user-facing requests shall have a response time of less than 500 ms under normal operating conditions.
- **Security:** Communication between NFC readers, mobile applications, web applications, and backend services shall be encrypted using industry-standard protocols.
- **Availability:** The system shall be available 99.5% of the time on a monthly basis.
- **Scalability:** The system shall support an increasing number of users, vehicles, and transactions without degradation of performance.
- **Usability:** User interfaces shall be intuitive and accessible, following modern UX standards.
- **Maintainability:** The system shall be modular and well-documented to allow efficient maintenance and future extensions.