Barrierfree Mobility for All by a Smart and Individual Travel Assistance

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***Abstract*—Public transport operators focus on a public transport system which is inclusive and fair to all groups of society. This requires a holistic approach, which considers the user and the service provider perspective. From the passengers' view, it becomes obvious that not only the accessibility of a single transportation system is relevant. The interchanges within the system as well as the change-over to other systems must be improved regarding the special requirements of people with reduced mobility and/or sensory restrictions. This article describes how this objective can be achieved in the project aim4it by an individual and smart solution, which is available and useable for every passenger-group. System components are presented and first results are pointed out.**

Keywords- cross-modal public transportation; barrierfree; smart solutions, customer-orientation.

I. INTRODUCTION

Every mobility chain is accompanied by an information chain, which has to be carried out at best parallel. Especially passengers with reduced mobility and/or sensory restrictions have to be informed in time about unexpected events and resulting changeover times. Also, for barrier-free information, the information has to be understandable, e.g., in sign language, as well [1].

Today, Intermodal Transport Information Systems (ITIS) manage the challenge to provide relevant pre-/on- and post-trip information to passengers [2]. But a barrier-free travel assistant includes information representation that is tailored to the specific requirements of passengers with sensory restrictions (e.g. information display in sign language). This increases perceived service quality and the usage of public transportation. With suitable evaluation algorithms, customer feedback can be systematically elicited, evaluated and interpreted. This is the basis for a continuous improvement of public transport operations. Timetables can be adjusted or available digital maps advanced, service personal can be used more appropriate [3]. Overall this will result in a better quality of services for passengers with reduced mobility and/or sensory restrictions.

II. HOLISTIC APPROACH FOR BARRIER-FREE PUBLIC TRANSPORTATION

The project aim4it incorporates the user's and service provider's point of view. When a trip is viewed from the perspective of the customer/user, it becomes clear that it is not enough to design individual transport modes and facilities for just one transport system. In order to be passenger-friendly and suitable for use by passengers with special mobility needs (i.e., visually impaired passengers and the deaf and hard of hearing) all transport modes and therefore all service providers have to be considered for barrier-freeness [4]. For a given destination to be reachable by everyone, barrier-free *mobility chains for all transport modes* should be set up. Therefore, passengers with reduced mobility have to get all relevant information about departure times, necessary transfer procedures and updates/changes due to breakdowns. This information must be up-to-date and understandable at important nodes before, along, as well as after the journey. Significant information needs to be conveyed in optical, acoustical and/or tactile form [3].

III. COMPONENTS OF THE AIM4IT SYSTEM ARCHITECTURE

The intended overall aim4it assistance system provides a benefit from the user's as well as the service provider's point of view. Thereby, the aim4it smartphone app is the key element.

A. *aim4it smartphone app*

With the aim4it smartphone app the passenger can start the planning of the trip by entering information about the start and the destination into the smartphone at home. Data entry and display for the aim4it user interface are designed in an innovative user-centered way: All information provided will be displayed as multi-sensual output to secure information for the different groups of passengers. Afterwards the aim4it smartphone app sends a request for a barrier free trip to the ITIS [2].

B. *Link to Intermodal Transport Information (ITIS) and Transport Control Systems (ITCS)*

Based on the start and endpoint of the requested trip the ITIS performs barrier-free routing. The following Use-Case is considered: The route reflects information from augmented digital maps (e.g., based on crowdsourcing projects such as wheelmap), error messages from the Intermodal Traffic Control System (ITCS) as well as events entered by local service staff at stations (e.g. malfunction of an escalator). The barrier-free route compiled by the ITIS is sent to the smartphone app. There it is displayed for barrier-free navigation along the planned trip chain. An additional feature is the request for bus driver assistance, e.g., to board the vehicle. This is entered and sent to the ITIS. By the ITIS this

request is passed to the ITCS where the corresponding vehicle is identified. Via the existing data link between the ITCS and the vehicle the request for bus driver assistance is sent [2]. There it has to be displayed to the bus driver within the aim4it bus driver user interface when the vehicle approaches the proposed station.

IV. Value-added Services and their continuous improvement

With the aim4it smartphone app passengers with reduced mobility and/or sensory restrictions get on-trip assistance. This includes several services, which are described further below:

A. Incident information in sign language

Whenever service irregularities (e.g., delays, cancellations, missed connections) are detected in the ITCS error information is forwarded to the passenger. The aim4it message generator automatically transforms the text message to a video stream, *displaying error information in sign language* for deaf and hard of hearing passengers.

B. (Re-)Routing

In addition to just following a static pre-planned route dynamic *re-routing* is an integral part of the system. Using available information in the ITIS each barrier-free route will be monitored. Whenever a deviation is detected re-routing will be automatically activated and the passenger will be informed about alternatives.

C. Request for mobility assistance

On trip the passenger can make stop requests along with requests for bus driver assistance. This information is send to the vehicle by an IP-based communication link. Also, it will be displayed at the aim4it bus driver interface.

D. Request for connection protection

The same mechanism is used for the passenger request of connection protection. In this case, the request is generated by the aim4it smartphone app and send from the passenger in the feeder bus via ITIS and ITCS to the bus driver of the corresponding distributor bus. Waiting time of the connecting distributor bus at the interchange station will be extended.

E. Feedback for continuous improvement

With the aim4it smartphone app passengers with reduced mobility and/or sensory restrictions can provide feedback to the public transport operator (post-trip perspective) for continuous improvement [5]. Therewith public transport operators can enhance their service, e.g., for barrier-free transport services. Further feedback can be entered to various quality aspects (e.g., vehicles conditions, service staff). This information will be sent to the aim4it evaluation and planning tool for reporting. Information can be used for schedule updates or service improvements. In case of schedule updates, these will become effective and be the basis for operations monitored in the ITCS. Then, trip requests sent to the ITIS. Based on available customer feedback, digital maps can be revised and additional features added. These additional features can be used for generating barrier-free trips in the ITIS.

V. Conclusions

A demonstrator of the aim4it architecture is currently been developed by the consortium members. Results of the project will be demonstrated in the city of Vienna (Austria) as well as the city of Karlsruhe (Germany). The value-added services for travel assistance based on the technical specifications that result from the previous standardization project for IP-based communication in public transport (IP-KOM-ÖV). The Association of German Transport Companies (VDV) will continuously update these technical specifications. They are open to future adaptations and amendments. As the value-added services developed in the aim4it project (connection protection and request for bus driver assistance) build on and further enhance this standard, the results will result in a new work item proposal in the standardization procedure managed by VDV. Following this procedure the changes and amendments to the technical specifications suggested by the aim4it project will be discussed in a forum of domain experts and incorporated into a revision of the Travellers‘ Real-time Information and Advisory Standard (TRIAS).

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