Smart-phone assisted travel assistance for passengers with reduced mobility

Public transport, passenger information, reduced mobility, accessibility, assistance application

Public transportation is a main factor for reliable mobility in urban and rural areas. Every user group and their specific requirements have to be considered during planning and realization of public transportation services. Hence public transport operators have to ensure a barrier-free public transportation service. Certainly this barrier-freeness still is not realized for every user group, due to the high complexity of public transportation systems. This article outlines an individual travel assistance application for smart phones which can be easily integrated into existing background systems of public transport operators.

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People wish to be independently mobile. Local public transport plays an important role in enabling everyone to fulfil his or her individual demand for mobility. At the same time, mobility is a prerequisite for social inclusion both in urban and rural areas. However, for people with disabilities as well as for people with reduced mobility barrier-free access to public transport is of great importance. Around the world, there are over one billion people with disabilities. In Germany, the figure is around 9.6 million, which is about one in eight of the population. Seamless accessibility covering the entire transport system requires structural works, vehicles as well as communication systems so that they can be used by all mobility-impaired persons without great difficulty and largely without the help of others. The project aim4it (accessible and inclusive mobility for all with individual travel assistance) is an example of a comprehensive information and communication system designed to significantly reduce currently existing barriers in public transport. This article introduces the underlying system architecture as well as the use cases supported by it.

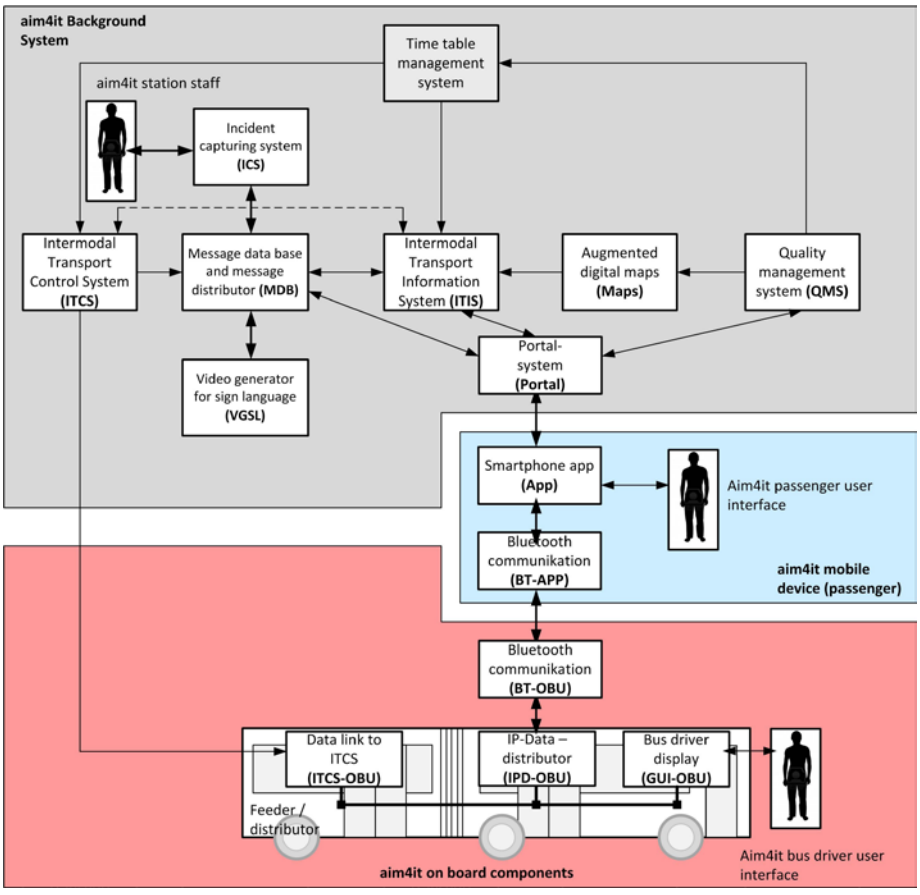

Figure 1: Overiew of aim4it system architecture

Overview of the Aim4it System architecture

The project aim4it integrates into the existing information and communication technology currently used by public transport operators. The aim4it system architecture consists of a background system, a smartphone application as well as a driver interface. The main system elements with the existing links between them will be explained in the following. *Figure 1* shows an overview of the aim4it system architecture.

The *Intermodal Transport Information System* (ITIS) provides travel information services for passengers. With the use of mobile devices passengers connect to the ITIS using standardized internet protocol-based communication (TRIAS, Travelers' Real-time Information and Advisory Standard). The TRIAS interface consists of a modular set of services where each service has a well described interface. These services can be consumed either directly by the travelers'

mobile clients or by immediate systems which could provide additional services for its users [1]. With the ITIS passengers can plan their trip and receive further information while they are on their trip (e.g. available updates about their scheduled travel as well as necessary connections in between).

There is no direct connection between the passengers' mobile devices and the ITIS. A dedicated gateway (*Portal system*) is introduced to abstract from the specific mobile device used by the traveler. This layer of abstraction is required because there are many limitations for mobile devices with respect to energy consumption, connectivity and also the capabilities of the operating system. The *Portal system* can handle all these limitations. For example the gateway can use different Push-Services for the different smartphone operating systems [1].

The *Intermodal Transport Control System* (ITCS) transmits information about the current operational status of the public transport system to the ITIS. The ITCS has a bi-directional data-link to the vehicles (e.g. professional mobile radio or a public land mobile network) and receives all vehicles' current positions. Furthermore the ITCS supports decision making by the operator and broadcasts information to the vehicles. In the aim4it project vehicles receive requests for prolonged waiting times at interchange stations for connection protection as well as requests for staff assistance at specific stations.

By means of the *Incident Capturing System* (ICS) passengers can be informed about currently existing irregularities in the provision of public transport operations. The public transport operator can enter information about the nature of possible disruptions and/or modifications of public transport services. These messages can also be used in the ITIS for an automatic calculation of route updates that travelers receive with a push-update. With this information on hand, passengers can decide whether to wait or to take an alternative route. ICS support collection, management, and publishing of passenger information related to service irregularities in any form or medium [2]. This digital content can take the form of text, announcements or video files with messages being displayed in sign language using an avatar (see description of use cases below).

Use cases supported by the aim4it system

With the architecture described above, several use cases will be supported. The use cases will be further explained below.

Figure 2: Bus driver display showing entry wish of wheel chair user at next station

(Re-)Routing: In order for a travel assistance application to effectively serve as a "guardian angel" guiding the passenger from start to destination the planning and execution of routes needs to be considered in detail. Initial planning of a route from start (street address or point of interest) to a destination is at least as important as calculating updates of routes once a previously defined route becomes impracticable (rerouting). Different events during a trip can trigger a rerouting.

(1) Real time passenger information (RTPI) reveals delays in the public transport network. Once a route is affected by a delayed vehicle a new route will be generated and sent to the respective passenger via a push-update.
(2) Incidents in the network (e.g. an accident) have an impact on available public transport services and require passengers to take an alternative route.
(3) The passenger is not at the right location at the right time and misses the vehicle.
(4) The passenger actively changes his plans and asks for an alternative. This can be a change or a cancellation of an existing route.

In case the passenger has "booked" additional service features with his initial route re-routing has an impact on other use cases supported by the aim4it travel assistance application, e.g. "request for staff assistance" and request for "connection protection". Input parameters for these use cases will be updated or requests will be cancelled.

Request for connection protection: There are only some of the wide range of possible trips in a public transportation network which are realized by direct connections. Often interchanges are required. To provide a dependable service for passengers transport, operators directly monitor connections. If needed, the connecting vehicle can wait for passengers of the feeding vehicle. With aim4it the connection protection request takes into account that passengers with reduced mobility or sensual restrictions need a longer transfer time between the vehicles. Based on this service the connection will be guaranteed and the passenger will be informed in time. The driver of the receiving vehicle will be informed about the prolonged waiting time at the demanded station. In addition connections can be cancelled if no longer required (e.g. due to re-routing) to avoid delays.

Incident information (in sign language): All passengers need to get access to detailed and reliable information regarding their trip. To provide such comprehensive information by the travel assistance application for sensory restricted passengers, this information has to be provided in an appropriate way. Barrier-free information includes the media supplying the information for the passenger. The aim4it project pays special attention to the demands of deaf and hearing-impaired passengers. This passenger group has difficulties in deciphering complex linguistic structures. Therefore the relevant information will be provided by sign language-based avatar videos [3].

Request for staff assistance: Staff assistance (e.g. by the driver) provides an easier usage of public transportation for passengers with reduced mobility or sensory restrictions. For trip assistance services the passenger must make a reservation via the aim4it travel assistance application. This has to be carried out prior to the trip. With the direct communication from the ITCS to the vehicle the request is displayed to the driver (see example of driver display in *figure 2*). The staff member awaits the passenger with mobility or sensory restrictions at the previously defined station and helps the passen-

Figure 3: Recognition of which line the approaching vehicle is assigned to with direct communication between smart phone and vehicle

Figure 4: Placement of entry wish with direct communication between smart phone and vehicle

ger to board the vehicle. At the designated station the staff member helps the passenger to alight from the vehicle.

In-vehicle passenger information: IP-based communication will be realized by introducing wireless communication between the aim4it smart phone application and the public transport vehicle by means of a Bluetooth 4.0 interface. Thereby waiting passengers can recognize which line the approaching vehicle is assigned to (see example in *figure 3*). Furthermore, additional information is sent from the vehicle to the smart phone application in the vicinity of the vehicle and on board. This contains information about the direction of travel, route and stop sequence, real-time information to catch connected services. Also deviations from the scheduled timetable can be sent. In addition to this the passengers with reduced mobility or sensory restrictions can place requests for staff assistance as shown in *figure 4*.

Feedback function: Public transport operators strive for continuous improvement of service quality of passenger transport. To do this the passengers have to be surveyed and actual performance continuously monitored [4]. With the aim4it feedback function passengers with sensory restrictions or reduced mobility will be involved in this improvement process. Service quality can be measured with the help of direct performance measurements derived from observing all transactions between the passengers' smart phone application and the central portal system. This information is combined with data from surveys embedded into the smart phone application. After specific events along the trip the passenger will receive a questionnaire where he/she is asked to rate satisfaction with a specific item. With the help of the assessed performances and opinions of the passengers the public transport operator can improve the performance level of service execution. The public transport operators can set up the right priorities for the adaptation of existing facilities and services to the requirements of passengers. In addition, gathered requirements can be taken into account for further design and planning of public transportation systems.

Conclusion and Outlook

The project aim4it develops a travel assistance application which allows public transport operators to make a significant step towards providing public transport services which are inclusive and accessible.

The project aim4it develops additional functions and services which have not been part of a initial standardization project (IP-KOM-OEV) carried out under the initiative of the Association of German Public Transport Companies (VDV) [5]. The aim4it interface descriptions agreed on within the project consortium will result in work item proposals for subsequent standardization performed by VDV. VDV will continuously update its standards and will perform annual reviews of necessary changes to the IP-based communications interfaces to the on-board equipment and the real time passenger information system. Standardization of project results ensures that the aim4it travel assistance concept can be easily transferred to other regions. In February 2016 the prototype system will go into operations in the city of Vienna (Austria). In March 2016 the prototype system will start operations during the IT-Trans trade fair in the city of Karlsruhe (Germany). ■

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