MARIA – Mobile Assistance for Barrier Free Mobility in Public Transportation

Lucas Paletta, Reinhard Sefelin, Joachim Ortner, Jutta Manninger, Regina Wallner, Marianne Hammani-Birnstingl, Verena Radoczky, Patrick Luley, Walter Scheitz, Otto Rath, Manfred Tscheligi, Burkhard Moser, Katrin Amlacher, Alexander Almer

(Lucas Paletta, JOANNEUM RESEARCH ForschungsgesmbH, 8010 Graz, Austria, lucas.paletta@joanneum.at)
(Patrick Luley, JOANNEUM RESEARCH ForschungsgesmbH, 8010 Graz, Austria)
(Katrin Amlacher, JOANNEUM RESEARCH ForschungsgesmbH, 8010 Graz, Austria)
(Alexander Almer, JOANNEUM RESEARCH ForschungsgesmbH, 8010 Graz, Austria)
(Reinhard Sefelin, CURE - Center for Usability Research and Engineering, 1110 Vienna, Austria, sefelin@cure.at)
(Manfred Tscheligi, CURE - Center for Usability Research and Engineering, 1110 Vienna, Austria)
(Joachim Ortner, C.C.Com Andersen & Moser GmbH, 8074 Grambach, Austria, jortner@cccom.at)
(Burkhard Moser, C.C.Com Andersen & Moser GmbH, 8074 Grambach, Austria)
(Jutta Manninger Graz AG – Verkehrsbetriebe, 8010 Graz, Austria, j.manninger@grazag.at)
(Walter Scheitz, GEFAS Steiermark, 8010 Graz, Austria, gefas@generationen.at)
(Regina Wallner, GEFAS Steiermark, 8010 Graz, Austria)
(Marianne Hammani-Birnstingl, Verein DANAIDA, 8020 Graz, Austria, marianne.hammani-birnstingl@danaida.at)
(Verena Radoczky, Mentz Datenverarbeitung Austria GmbH, 1060 Wien, Austria, radoczky@mentzdv.at)
(Otto Rath, ISOP Graz, 8020 Graz, Austria, otto.rath@isop.at)

1 ABSTRACT

The objective of MARIA is the development of a mobile service for continuous assistance with the purpose of barrier-free usage of public transportation. Relevant social communities such as elderly people, illiterates and immigrants are completely involved in technical design and evaluation. The innovative service includes image based text recognition and translation, location awareness and mobile speech recognition.

2 INTRODUCTION

2.1 Motivation

Use of public transportation is an essential prerequisite for barrier-free mobility and from this for long-term integration in social environments. The richness in the information offers in public transportation nowadays may also cause counterproductive consequences with respect to the usablity of already existing services. In particular, there may occurr problems if the information cannot be perceived and understood appropriately. This may occur in the case of (1) elderly people with problems in recognition and with cognitive impairments, of (2) immigrants with initial lack of expertise about a local language and (3) functional illiterates with principal problems in the understanding of text. In common is a request for moving forward a fundamental step for the integration of the mobility of these groups by introducing an assistive technology for barrier-free usability of public transportation, especially for autonomous access to textual information.

The project MARIA is targeting at the following objectives,

- Mobile assistance for social target groups. In contrast to previous only highly local supportive systems, MARIA develops a service for continuous assistance and support of passengers, especially in critical situations (selection of traffic lines, navigation, entering and leaving vehicles).

- Image based assistive technology for intelligent access of appropriate information spaces. Information text at bus stops and in trains can represent a challenge and form barriers in language comprehension and understanding. MARIA offers a service for image based text recognition and automated translation for the better usage in public transportation as well as in everyday situations.

- Information interaction with public transportation infrastructure for a most actual information access. Only the access to actual, most essential information (coach position, delays, etc.) enables efficient and comfortable assistance behaviour for the benefit of the passenger.

- Iterative integration of social requirements during the entire development process and the associated usability research. MARIA guarantees through its professional treatment of social requirements a fundamental, actual and complete consideration of social target groups within the design and functioning of the technology.

- Semantic analysis of ways of social target groups. MARIA enables the analysis of anonymised protocol information (geo-information, interactions, reported data, decisions) and from this a semantic evaluation of ways and objectives of the targeted groups.

The basis for this technology is mobile phones that are already available on the market, with graphical displays, a camera and innovative image analysis methods. The scenario is to direct the mobile camera to a public transportation sign (bus stop) or a textual region (at the bus stop or within the train) and to receive audiovisual information for assistance, for example, by text to speech or easily understandable graphical instructions. MARIA includes an intuitive assistance for barrier-free use of public transportation. Images of signs or text are analysed, the context associated and the system may start appropriate assistive behavior to support the user.

MARIA significantly discriminates from previous projects via its professional treatment of socially relevant groups into the process of technical developments. Profile of requirements, interaction design and iterative development using evaluation results are determined, accompanied and decided by the social target groups. MARIA represents a fundamental step towards a really efficient integration of social groups for barrier-free transportation.

2.2 Related Work

An essential feature for a barrier-free usage of public transportation is an appropriate access to information about navigation in terms of bus lines and hours. Information about routing from location A to B is offered within any major public transportation provider and its internet based representation. It has been recognised, however, that this information should as well be available for the mobile user, the passenger in the field. Therefore these services are provided for mobile phones in order to offer the clients to plan their trip independent on time and space. All major of such systems of public transportation providers in Europe do not adjust these services to special target groups and favour the „all-for-one" type design. Actual systems are focussing on routing information and can be subdivided technically into three major categories, (1) simple information pages available in the internet, these are adjusted for the mobile phone specific presentation, (2) applications that are specially designed for mobile phones, these require mostly a continuous connectivity and data exchange, or that store specific route information for off-line processing thereafter, (3) mobile services that carry the complete routing information statically on the phone and that do not need connectivity. The most simple systems are based on a homepage that can be opened via a preinstalled browser, such as the system of Nürnberg[1], that does not actually provide assistance. Other systems provide information about specific routes that can be used without any costs for connecting, such as is used by the Verkehrsverbund Berlin Brandenburg[2]. A typical off-line service is provided by the Münchner Verkehrs- und Tarifverbund GmbH that integrates the complete map of the urban public transportation[3]. The state-of-the-art is defined by the software „Quando"[4] that is offered by the Wiener Linien and Verkehrsverbund Ost-Region (VOR) since 2009, including a real-time information about the state of the public transportation, routing, GPS based local assistance additional services for ticketing, interactive city maps and temporally appropriate event information. The Austrian project „MIP" (Mobile Information Point) develops highly local information support with support of mobile cameras (QR coding) and near-field communication (NFC)-technology.

In contrast to the other mentioned systems, MARIA enables a functionality for continuous assistance with image recognition technology that can be universally applied and forces a precise analysis and application of user requirements through the associated usability research. MARIA's intelligent service with barrier-free assistance is at the moment neither under investigation nor available on the market.

3   MOBILE ASSISTIVE TECHNOLOGY IN PUBLIC TRANSPORTATION

Current passenger information and routing systems are usually accessible via the homepage of the corresponding transportation service provider. From this the service is only available with standard web browser usage and causes problems because these browsers are not optimised for the mobile phone type display. Furthermore, the performance of web browsers on the mobile is not comparable with those available at desktops, regarding dynamic content and interactivity. Partially these problems have been covered with specific software such as in quando, offering routing about usage of public transportation, however, intelligent assistance for supporting the user at the navigation points – where the media of transportation is

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[1] www.vgn.de.
[2] http://www.vbbonline.de
[3] www.mvv-muenchen.de
[4] www.qando.at

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changed - is not part of it. This is the reason why these kinds of systems are not suitable in case of barrier free guidance and impose difficulties for orientation and understanding.

The project MARIA intends to provide a mobile assistance for barrier-free navigation, targeting at social groups with problems to orientate and understand standard type guidance information, and in this way contrasts to any other system available at the moment. MARIA will be developed in terms of a separate application for modern mobile phones and will continuously assist the passenger on its way. Intelligent guidance is provided through an on-going computation of geographic and semantic context that enables the service to appropriately react in response to characteristic situations without the need for interaction by the user. Context recognition takes advantage of nowadays multisensory equipment of mobile phones, for example, to decide whether the user is taking a stroll in the city or using a tram or bus. Position and acceleration sensing, digital compass and GPS/GALILEO receivers are provided to support the contextual computing unit. A typical example for contextual support is requested at navigation connection points: the unit will analyse whether the user enters the targeted tram line or not, and if not, the system can appropriately respond for further support. MARIA will also develop towards extended usability in terms of the design of the mobile graphic display that will be in contrast to the de-facto standard. The graphical user interface will be designed according to the requirements defined by the targeted social groups, in order to guarantee a most comfortable usability.

The assistive mobile service aims at the implementation of a interface between the user and the MARIA system. The passenger should be enabled to use all functionalities independent on choice of time and locaton. The key features targeted at are as follow,

- Intuitive user interface: The user interface provides access to all functionalities via specific a social group specific user interface according to the requirements determined by usability analysis.

- Intelligent navigation assistant: Implementation of real time navigation and bidirectional passenger service. Implementation of user specific intelligent guidance with appropriate speech output. This will include on the one hand consideration of various information sources for the actualisation of time plans, information about position and delays. Furthermore, the navigation assistant will be equipped with moble augmented reality functionality to overlay the real-time camera image with guidance information.

- Context recognition based on multisensor information for the support of navigation. The automated context recognition system will be capable to interpret movement patterns and from this the behavior of the mobile users, and finally conclude about appropriate mobility of the target user. In case of deviations to the planned behaviors, the intuitive interface will activate appropriate functionalities in order to alert the user and inform about a targeted compensation behavior.

- Integration of the camera interface for real time augmentation of navigation information.

- On-board service. There will be an interface from the mobile service to the bluetooth based infrastructure within the coach. This service will enable to utilize informations about the status of the coach, such as, opened doors or position of the coach within the city map, that support intellitgent navigation and interaction with the passenger.

4 MOBILE ASSISTIVE VISION SERVICES

The project MARIA will initially make use of marketed standard software for text recognition that will be applied in the mobile service for the specific target groups. The user points his camera phone towards a text, such as information by public transportation, snaps a photo and receives in turn the translation of the text using earphones or the loudspeaker of the cellular. In case of immigrants we intend to use an automated language translation service. In cooperation with usability research and professional translators with experience with immigrants we will attain an appropriate mapping from text to a translation of most used phrases. A software that was used for the identification of medicaments (Kalcher et al., 2006) will become the basis for further research and development in order to develop a robust service. The objective is to develop a service that is operating in real-time and in a robust way since text recognition in real world outdoors is a challenge. In addition, a mapping between public transportation signs, such as at bus stops, and appropriate information services is considered. The software will be based upon mobile vision services for geo-indexed object recognition in urban environments (Paletta 2007; Amlacher et al., 2008a,b).

The camera phone will act as an "intelligent loupe" to the passenger, including the functionalities of (i) text detection with mobile images, (ii) recognition of general text in images, for the (iii) magnifying of recognised text and for (iv) the translation of text in foreign language into the specific mother language of the passenger, and (v) for acoustic presentation of recognised text. Initially, the loupe will operate in client-server mode. Finally, a client based service will contain relevant functionalities for computer vision for the rapid interpretation of text at the site. The intelligent loupe represents a central element for the implementation of barrier free mobility in public transportation and can be used by passengers as well for support in everyday life. Research towards a robust service is challenging because image based services are seriously dependent on illumination conditions and thus represents an active field of research.

5 USABILITY ANALYSIS TARGETING AT KEY SOCIAL GROUPS

5.1 User Centred Design

The key idea behind MARIA is to develop a user specific service that is in contrast to all existing general purpose public transportation services. In contrast to the "design for all" concept (Stephanidis, 2001, 2009; Shneiderman, 2000) there exists a cocept for multimodal interaction that makes use of audio and voice (Benoit et al., 2000; CURE, 2004), eye movements (Forbus et al., 2003), and mobility (CURE, 2004) or haptic interactions (Yonezawa et al., 2008) that aims at identifying the various requirements of specific user groups. Multimodale interfaces enable sequential, parallel, independent and combined interactions (Olwal & Höllerer, 2005). Furthermore, the emotional status of the user and his reactions can be extracted and classified (Glowinski et al., 2008). In MARIA the focus of usability research is on the investigation and evaluation of user experience factors, with respect to the individual social target groups and types of ways that are travelled by the passengers in natural mobile environments. Results of this investigation should impact the design and the functionality of the mobile service.

MARIA involves a user centred design strategy with direct involvement of the user in order to attain universal accessibility, usability and user experience. Focus groups will be investigated together with specific user groups to develop scenarios for the use of the MARIA functionalities. Problems and requirements will be protocolled and mapped to a valid support of the technological development process. Living Lab methods (z.B. ESM, Remote Usability Testing) will be investigated that deliver in real-time information about the usage of the system, interactions and user experiences in interaction with a specific system version in the natural environment.

5.2 Elderly People

There is a wealth of products that is specifically suited to elderly people, such as the Nokia Emporia phone. For the development of these technologies, the cognition and the physical constraints of elderly people should be considered in both design and functionality. However, in contrast to the exhibited sensibility for problems and requirements, the use of technical equipment still remains a grand challenge to elderly people. Most important, the inclusion of elderly people into the design process is a major issue in order to guarantee improvement of their quality of life. In MARIA it is important to develop a continuous service for assistance which is a major concern for support of the perception of the environment and the mobility of elderly people.

5.3 Immigrants

Immigrants are experiencing many barriers for participating in public space, such as, use of foreign language, different scripture and use of functionality in public transportation. Immigrants with initial knowledge of local language are often misguided by misapprehension. In the city of Graz, announcements in English are not helpful for the majority of immigrants that originate from Turkey and East-European countries. Immigrants therefore need support, mostly through family members if available, another strategy is to avoid public transport. A specific target group consists of low educated females and young mothers that need support about the cultural use of public symbols, about how to autonomously proceed with their kids in the urban environment. The objective in MARIA is to provide the mobile service to immigrants with neglectable knowledge in German language that recently entered Austria, some immigrants are illiterates that need special support. The mobile service will be delivered as part of a „welcome package" to immigrants in Graz.

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5.4 Functional Illiterates

Functional illiteracy refers to the level of competence in reading and profoundly depends on the social and the temporal context of the individual. The information and communication society imposes specific challenges on the individual that cannot be met by 10-20% of the public according to studies of OECD International Adult Literacy Survey, PISA and estimates of the European Parlament. The key problem for illiterates is navigation that mostly is based on text within urban environments (including maps, graphics, etc.). Functional illiterates proceed mostly on well known routes, whereas new targets, such as at hospitals, impose barriers that cannot be passed by illiterates. The innovative technical solutions in MARIA are therefore highly relevant for this specific social group.

6 CONCLUSION

The application of mobile services for specific target groups and the resulting benefit for the passenger will cause in parallel improvements in economics. The project MARIA aims at an increased involvement of elderly people and immigrants in public transportation due to the better support in navigation and assistance in critical situations, such as in decision points for navigation. The focus on meeting the requirements of specific user groups will enable a tight binding of these passengers to the public transportation services which finally represents a modal shift resulting in less pollution of the urban environment. At the same time, the citizens become more satisfied, can act better according to their true interests and from this communication and investment will be intensified in the urban environments.

7 ACKNOWLEDGMENTS

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