How can blinds get information in Public Transports using PDA? The RAMPE Auditive Man Machine Interface

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Abstract. This paper describes the RAMPE system for the mobility and autonomy of blind people in public transports. It is intended to equip bus or tramway stops or to be installed in poles of transport interactions. In the system, the user carries a smart handheld device (PDA) that communicates by a wireless WiFi connection with fixed equipment in the bus or tram stations. A special care has been given to the design of the man machine interface and to the management of priorities in the real-time vocal information application.

Keywords. Assistive device, blind, Intelligent Travel Information, PDA, WiFi, auditive MMI

Introduction

Using bus or tramway public transportation is very difficult for blind people. At the present time, there are few systems available for the assistance and information of blind persons in open urban environment. There exist some systems based on infrared (IR) or radiofrequency (RF) devices. such as those used for traffic lights repeaters. One can quote the "Talking Signs"® Remote Infrared Audible Signage RIAS solution [1, 2, 3], used is some towns of USA and Japan. There also exist auditory systems activated by RF remote control such as EO-guidage® from the company EO-EDPS. Both types of existing systems (IR and RF) have been experimented and evaluated during the BIOVAM French PREDIT project [4]. They lack of interactivity and of adaptation to the user and the environment.

In this paper, we present the RAMPE system for the mobility and autonomy of blind people in public transports. It should equip bus or tramway stops. The user carries a smart handheld device that communicates by a wireless WiFi connection with fixed equipment in the bus or tram stations. The application on the PDA presents and filters vocal messages. It adapts itself to the type of information system available at the stations. It reacts to real-time information sent by the stations. The man machine interface (MMI) has been designed with a special care for the management of priorities. No specific hardware development is necessary.

The paper is organized in 6 sections: context of the project, need analysis, MMI, system overview, information type and XML structure, PDA software application.

1. Context and Framework of the RAMPE Project

RAMPE is supported by the PREDIT 3 under the general thema of services for mobility and accessibility for persons with reduced mobility. PREDIT 3 is a French Program of Research, Experimentation and Innovation in the field of land Transport.
RAMPE started in January 2004. It is conducted by three complementary partners: ESIEE, LUMIPLAN, and LEI. ESIEE is a center for higher education and research in information and communication technology. LUMIPLAN is a company designer of information products and services in transports. LEI is an education and research laboratory of the university PARIS 5 in the field of ergonomics and computer sciences.

2. Need Analysis, Diversity of Situations

Former studies of the blind pedestrian locomotion [5] and experiments [4], semi-directing interviews and the direct analysis by observations of intermodal urban movings (train/subway/bus) of the Visually Impaired Persons (VIP), enabled us to bring out their strategies of preparation and especially of moving.

Their behavior is guided by different concerns of which three categories appear priority: safety (to avoid risks of falls and collisions), localizations (not only the localization of the person in an abstract trip made of numbers, directions, names of interchanges or stops, but also the localization of the multiple pieces of equipment and boundaries encountered or crossed to enter or leave a vehicle (bus stops/entry of a subway station, input/output of a platform, presence of a vehicle and position of the doors of bus/subway/train...) and reliability, i.e. the difference between the reality and their mental representation of their situation during the trip..

Among the three modalities of transport (train, bus, subway), the bus appears to be the most difficult to use: it is due to the multiplicity and the diversity of the causes of uncertainty (presence and localization of the stops, multiplicity of infrastructure configurations, of types of disturbances and of possible answers given by the network exploitation, vulnerability of transport to the contingencies of traffic...).

By formalizing the moving in four zones and the diffusion of information in three level of temporality (section 5), we locate in space and time the requirements in information putting in adequacy the user concerns and the diversity of situations. The four zones are: urban open zone (need of localization information: existence and location of stops), transfer zone (need of guiding information), access zone (need of factual information such as arrival of a bus) and inside vehicle (need of information about change in the environment). For the bus, the transfer and the access zones are merged. To reconstitute a virtual access zone is one objective of the RAMPE System.

3. Principles for the Design of the Auditive Man Machine Interface

Auditive interfaces are appreciated by the VIP, but a simple auditive conversion of visual information can lose any effectiveness and even become awkward or generator of risks: the sound diffusion is intrinsically fleeting, sequential and potentially intrusive. An auditive interface, in order to be and to remain effective during the trip, must have a feedback making it possible to synchronize the diffusion, the attention and the active listening, in a dynamically changing environment. Used by persons without vision in a dynamically changing context, this interface must be robust to avoid that the user or the application get lost. It must update as well as possible and at the right time the mental representation of the VIP situation in its trip. It must minimize the mental load, handle errors, control and maintain selectively the transmission and memory of information in a dynamically contingent space (VIP mobility, radio variability, threshold effects....).

Special care has been taken in the design of the MMI. It uses the PDA keyboard and an embedded Text to speech synthesis. The application can be in 3 different states of interaction: idle mode, task execution mode, vocal loop mode.

- In idle mode or task execution mode, only two possibilities are offered to the user: 1. do nothing or wait, 2. select and/or interrupt.
- In vocal loop mode, the user can: skip from one stage to the next one, reverse the vocal loop, switch on pause or silent idle mode,

The handling of the keyboard is dynamic and depends on the application state. For instance, an acknowledgement can be done with any key. Then the key recovers its own specific function. Because speech synthesis runs in a sequential way and does not allow to provide information in a parallel way such as display panels, the presentation of the information is designed to provide easy and fast access to meaningful data.

4. Overview of the RAMPE System

The RAMPE system (Figure 1) is based on:

- A smart handheld device carried by the user. This device is a WiFi enabled PDA running the RAMPE application software. The Man Machine Interface is realized by Text to Speech Synthesis and the keys of the PDA.
- Fixed base-stations installed at the bus stops. They include a WiFi Access Point and a loudspeaker that can be remotely activated by the user.

RAMPE application aims to provide the needed information to allow visual impaired people to face any situation they can encounter when they want to take a bus. One area can be made of a single or multiple stop points. Every stop is detected as a different base-station with its own name (see section 6 for the naming convention). First the user chooses to which stop he wants to be connected. Then the base-station proposes a guiding service using a chime, that the user can accept or not. Because the user is moving towards the stop, he could detect a new base-station or lose one; the RAMPE application provides information about this changing environment allowing new choice possibilities. Once the user is arrived at the stop, he chooses the line that interests him. Then, he can listen to the list of the main stops (skeleton) of the journey, then to all the stops. This can be seen as a zooming at different resolutions on the "map" of the journey.

5. Types of information and XML information structure

All the information available is provided by the base-station to the RAMPE application embedded in the PDA. This information is of three different types:

- Structural; this first category concerns structural information: Line numbers and names at this stop, theoretical schedules, contextual information.

- Short term; this kind of information can be seen as stable exceptions such as service interruption due to works along the journey, valid for a few days or weeks.
- Real-time; the last category stands for real-time information like sudden service break because of strike or accident, vehicle arrival, service messages.

Main static information comes from databases of the transport operator. Those data are structured using a XML framework specified either by a DTD (Data Type Definition) or by a XSD (XML Schema Definition). A lot of work has been done on XML structuration of transport information often in multimodal context. One pioneering work for the specification of public transport information model was the "transmodel" project [6] which is the basis for further works as "transXchange" [7] or "TPEG" [8]. In contrast to those works where the root of the XML hierarchy is at the transporter scale or message oriented at a country scale, the root of the local RAMPE database is the stop point, in this way it can be seen as a leaf of a more global XML model.

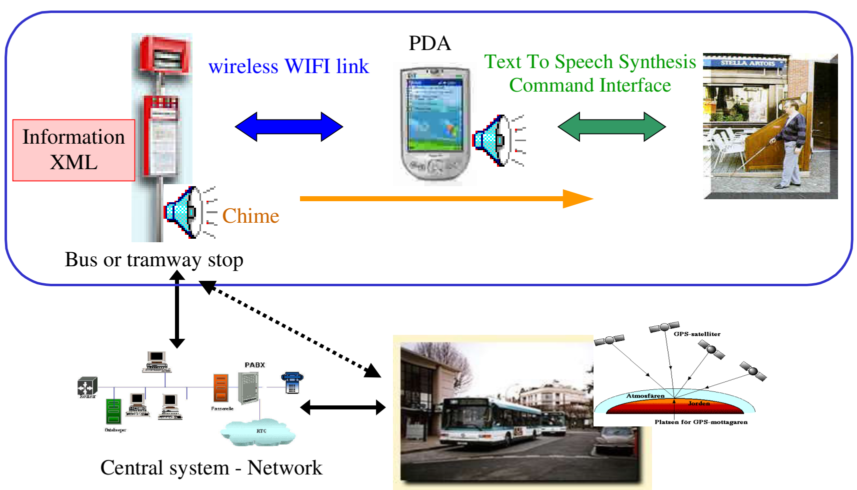

Figure 1. General Architecture of the RAMPE System

6. PDA Software Applicatin

The RAMPE application, embedded in the PDA, manages three actors : the user through the MMI (Man Machine Interface), the Network through the NIC (Network Interface Card, the WiFi chipset in our case) and the database (DB) through the XML file updated thanks to the network interface. The interaction between those three actors is handled by a finite state machine (FSM).

We now describe the FSM that is made of one initial state and 3 mains states. Each base-station broadcasts a periodical beacon with its SSID (Service Set ID), this SSID is a character string build in the following way: "RAMPEstopPointName/direction". This structure is mandatory, the root "RAMPE" allows to recognize base-stations belonging to the RAMPE framework. The “stopPointName” separated from the “direction” by a slash provides high level information about public transport offered in that area. This is done without any network traffic, just by collecting information in the air. This is the initial state. The user needs to acknowledge to go into the first state. This state goes from stop points enumeration and choice to the network connection, this requires WiFi association (MAC connection) and DHCP negotiation (Network connection). In case of failure an emergency message is issued and the application comes back in its initial state. Care has been taken to handle as much as possible all the failure traps caused either by asynchronous events or by user bad manipulation. This is the fact for instance if a new SSID appears during current enumeration, in this case the application is reset to the beginning of the first state. Once a base-station has been successfully selected, the application enters in the second state where it proposes a guiding service that has to be asked by the user thanks to a TCP frame. If it is not acknowledged, the application is reset to the initial state. The application goes into its third state at the end of the guiding service. In this state the XML database is downloaded using a HTTP-GET service. From this point, the user is able to browse through the details of the chosen line with some zooming capabilities.

An important feature of the RAMPE application is its ability to handle moving scenarios: change in the context (appearing or vanishing of a base-station), moving of the user, asynchronous events (such as vehicle arrival) provided by messages from the base-station.

Conclusion

This real-time embedded networked assistive device makes use of different technologies to provide the right information at the right time. The choice of general purpose PDA, WiFi and XML technology should facilitate the deployment of the system and enable the interaction with other services.

The prototypes that have been realized during the first phase of the project have validated the proposed approach from a technical point of view. The second phase will be dedicated to the in-situ implementation and assessment***.

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