The RAMPE Project: Interactive, Auditive Information System for the Mobility of Blind People in Public Transports

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Abstract: *The RAMPE project aims to design, realize and experiment a system for the assistance and information of blind people so that they can increase their mobility and autonomy in public transport. It is intended to equip bus or tramway stops or to be installed in poles of transport interactions. It is based on smart hand-held Personal Digital Assistant (PDA) with embedded speech synthesis and able to communicate by a wireless WiFi connection with fixed equipment in the bus or tram stations. The main characteristics of the smart hand-held devices are: they can present and filter vocal messages, they can adapt themselves to the type of information system available at the stations, they can react to real-time information sent by the 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: real-time information system, assistive device, blind, Intelligent Travel Information, PDA, WiFi.

1. 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. Fixed transmitters installed in different locations (administrative buildings, commercial centers, bus stops) continuously emit an infrared beam containing vocal information messages. Users scan the environment with hand-held receivers and when the receiver intercept an IR beam, the vocal message is restituted on the receiver loudspeaker. The user can thus discover what is in his proximity and can be guided towards the location of the emitter.
- There also exist auditory signages or systems activated by RF remote control such as EO-guidage® with the EO/COM receiver from the company EO-EDPS in France. One can also mention the equipments installed in the Czech Republic by the Prague Public Transit operator and private bus operators. Tramways and buses are equipped with special RF receivers and blind people activate an external announcement informing them about the route number and destination of the approaching vehicle. At the same time, the driver is warned that a blind person wants to get on board

Both types of existing systems (IR and RF) have been experimented and evaluated during the BIOVAM French PREDIT project.[4] dedicated to the study of the needs in orientation and information of vision impaired people in transport systems. The IR systems have been considered as difficult to use in the crowd. They have an interest because they give information centered on the direction of displacement of the person. But it was judged to be demanding on the cognitive level, due to the difficulty for the users of determining the position of the beacons. The RF systems were considered to be easier to use but not very effective in term of guidance. They presented difficulties of operation due to RF interference in closed places. Both types of systems, lack of interactivity and of adaptation to the user and the environment.

In this paper, we present the RAMPE project whose objective is to design, realize and experiment a system for the assistance and information of blind persons so that they can increase their mobility and autonomy in public transport. It should equip bus or tramway stops or be installed in poles of transport interactions. It is based on smart hand-held devices that are WIFI enabled Personal Digital Assistant (PDA) able to communicate by a wireless WIFI connection with fixed equipment in the bus or tram stations. The main characteristics of the smart hand-held devices are: they can present and filter vocal messages, they can adapt themselves to the type of information system available at the stations, they can react to real-time information sent by the stations, the man machine interface has been designed with a special care for the management of priorities, no specific hardware development is necessary – the PDA just runs the RAMPE software application. The choice of general use PDA, WIFI technology and XML (Extensible Markup Language) structuration of information should facilitate the deployment of the system and enable the interaction with other services.

The paper is organized in 4 sections plus an introduction and a conclusion. The first section describes the context of the project. The second one is an analysis of the needs of blind travelers together with ergonomics principles. The third section presents the general architecture of the system and its main features. The fourth section is dedicated to the technical aspects

2. CONTEXT AND FRAMEWORK OF THE RAMPE PROJECT

The RAMPE project 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 land Transport started in 2002.

The RAMPE project 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 science and technology specialized in information and communication technology. LUMIPLAN is a company designer of information products and services in transports, cities and industries. LEI is a education and research laboratory of the university PARIS 5 in the field of ergonomy and computer sciences.

During the first phase of the project, the prototypes have been developed and tested. This first phase have been rewarded during “Carrefour PREDIT” on march 2005.

3. ANALYSIS OF THE NEEDS, DIVERSITY OF SITUATIONS, ERGONOMIC PRINCIPLES

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 the risks of falls and collisions), localizations (not only the localization of the person herself in an abstract trip

Among the three modalities of transport (train, bus, subway), the bus appears to be the most difficult to use: it is 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 area and the diffusion of information in three key moments, we locate in space and time the requirements in information putting in adequacy the user concerns and the diversity of situations.

Auditive interfaces (vocal and sound) 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. The ergonomics of 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 from three points of view: to update as well as possible and at the convenient moment the mental representation of the VIP situation in her trip, to minimize the mental load and the handling errors, to control and maintain selectively the transmission and the memory of information in a space dynamically contingent (VIP mobility, radioelectric variability, threshold effects,...).

4. OVERVIEW OF THE RAMPE SYSTEM

The RAMPE system (Figure 1) is based on:

- A smart handheld mobile 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 to communicate with the PDA and a loudspeaker that can be remotely activated by the user.
- A central system that is connected both to the base-stations and to the vehicles (buses or tramways) by different communication means. The central system send information to the base-stations. This information can be theoretical or real time information about the vehicles, the position of which can be monitored using different positioning systems such as GPS.

The RAMPE project is focused on the PDA application and on the base-stations.

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 (the naming convention will be

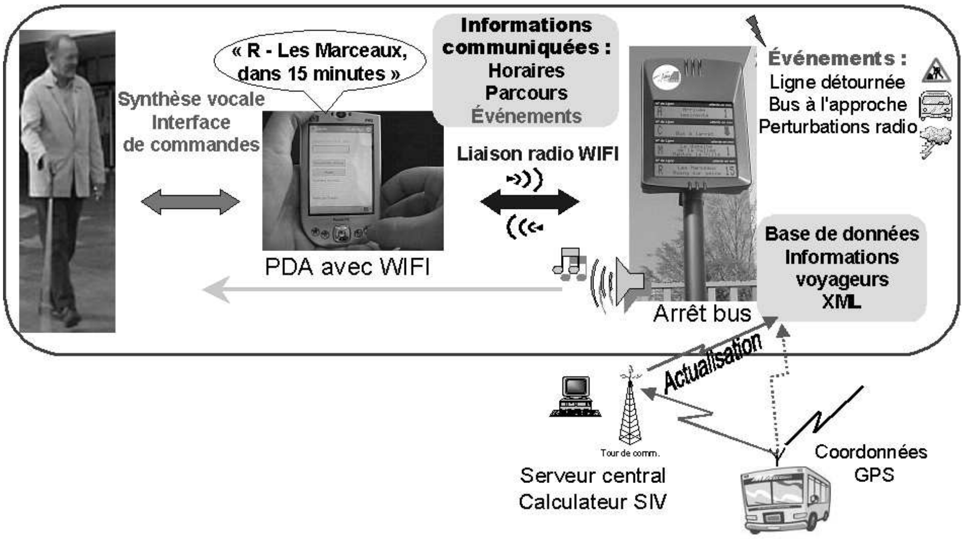

Figure 1: Architecture of the RAMPE system

examined in section 4. 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 has to provide information about this changing environment allowing new choice possibilities.

Once the user is arrived at the stop, he has to decide by which line he is interested. After that, he could 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. XML INFORMATION STRUCTURE AND IMPLEMENTATION ON THE PDA

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

- The first category concerns structural information: Line numbers and names that are served at this stop, theoretical schedules, contextual information.
- The second kind of information can be seen as stable exceptions like service interruption due to works along the journey, valid for a few days or weeks.
- 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 (Figure 2), in this way it can be seen as a leaf of a more global XML model.

The RAMPE application, embedded in the PDA, has to manage 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” allowes 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

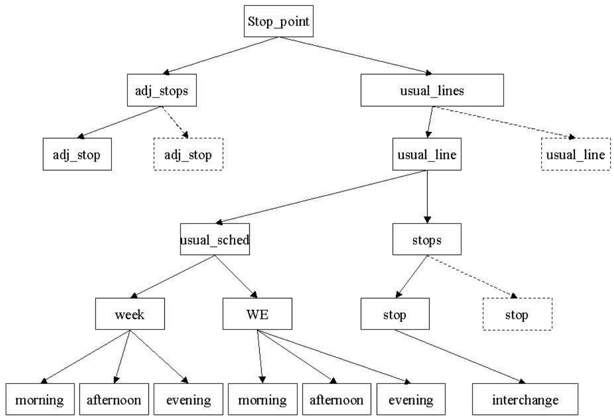

Figure 2: XML database structure (only elements are displayed, not attributes)

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 thanks to a HTTP-GET service. From this point, the user is able to browse through the details of the chosen line with some zooming capabilities.

Special care has been taken considering the MMI. It is realized thanks to the keyboard when information goes from user to the PDA and thanks to speech synthesis when the information goes from the PDA to the user. The handling of the keyboard is dynamic and depends on the state of the application. For instance when it needs an acknowledgement, it can be done with any key of the keyboard. After that 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 as could be done with a display panel, the presentation of the information is designed to provide easy and fast access to meaningful data.

The last important feature of the RAMPE application is its abilities to handle moving scenarios. Every change in the context is handled (appearing or vanishing of a base-station). It is able to handle asynchronous events provided by messages from the base-station. Finally, it can be said a data driven application because all its behavior rely only on the database structure and content, external events (vehicle arrival, service events,…), external context (number of base-stations).

6. CONCLUSION

This real-time embedded networked assistive device makes use of different technologies to provide the right information at the right moment. 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 site implementation and evaluation.

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