The Chatty Environment – A World Explorer for the Visually Impaired

Vlad Coroama
Institute for Pervasive Computing
Swiss Federal Institute of Technology (ETH) Zurich
8092 Zurich, Switzerland
+41 1 63 26087
coroama@inf.ethz.ch

ABSTRACT

Ubiquitous computing systems have often suffered the criticism of providing only marginal value and not justifying the serious amount of money spent for research in this area [1]. In this extended abstract, we describe the vision and the prototype of a ubiquitous computing environment for visually impaired people. The aim is to help them orient themselves in new, unknown environments and thereby enable them to lead a more independent life.

Keywords

Ubiquitous computing, visually impaired.

INTRODUCTION

Everyday Problems for Visually Impaired

Visually impaired people encounter many problems during their daily routine that sighted people wouldn't neccessarily think of. Take for example shopping in the local supermarket. Thousands of items, feeling all the same, spread over dozens of shelves, all the same shape. Visually impaired people will typically only go shopping to their local supermarket and buy only few products in well known locations. Or think of a modern airport terminal. Where is the check-in counter for a certain airline? Where does one collect the luggage after landing? Without external help, these issues are almost unsolvable for the visually impaired.

The Basic Idea

The common source of these problems is that the world reveals itself to us mostly over visual stimuli, which are being withheld from visually impaired people. To cope with some of these problems, we propose the paradigm of a *chatty environment*. In this environment, the world uses an alternative channel, namely audio, to reveal itself to the user. While walking by, entities in the environment keep talking to the user, thereby revealing their existence: "Here is the shelf with milk products, down the next aisle are the fridges with meat and ice", "Here is track 9, do you want more informations on the departing trains?"

This (at first sight rather naive looking) feature of the system will probably seem annoying to most sighted people. An environment talking endlessly to the user sounds like a headache to many of us that we would surely turn off after a few minutes. However, speaking to members of the Swiss Association of the Blind, it turns out that for visually impaired people there can almost never be too much audio stimuli. This is comparable to the huge amount of visual informations sighted people pick up every second, few of which they really use. Here, too, it feels far from annoying to continuosly receive that much unneccessary information since one has learned to focus on the interesting aspects only.

THE SYSTEM

We are currently in the process of building a prototype of the chatty environment as part of the ETH Zurich campus. The prototype consists of several components: a large number of tagged entities in the environment, a *world explorer* in form of a portable device for the visually impaired user, and a tag reader connected to the world explorer to pick up the tags.

Smart Entities

The objects of the chatty environment are electronically tagged, either by passive tags – using radio frequency identification (RFID) technology – or active tags – these could for example be active RFID tags, Berkeley TinyOS Motes [3], or Smart-Its [4]. The main requirement is that the communication between the tags and the user device does not need line of sight. Not only do we want to follow Weiser's vision of a ubiquitous computing system that works unobtrusively in the background without requiring explicit interaction [2], we also need to make sure that a system for the visually impaired does not require the user to point the portable device to a certain object for triggering an action. Therefore, infrared beacons are not suited for tagging the environment objects. In our prototype, we use the Berkeley Motes.

World Explorer

The portable device carried by the user receives the data transmitted by the environment objects. It can be either a stand-alone device carried by the user in her pocket or backpack, or an extension of the user's cane.

The most important data the smart entities send is their identity, such as "ticket booth", "escalator", "men's restrooms", "track 9", or "train to Geneva".

The device we are currently using as world explorer is an iPaq PocketPC, which will be replaced in a later project phase by a PDA especially designed for the visually impaired. These devices have the advantage of providing Braille input and output.

User Interface

The chatty environment keeps revealing itself to the user until she chooses to investigate one of the environment's objects. By pressing a button on the device shortly after an

environment object has been presented to her by the device, the user is capable of selecting this object.

The user is then presented with a standardized audio interface to the object. In the current implementation, the interface consists of four options:

Information

By choosing this option, the user receives further information about the chosen entity. This information is highly dependend on what kind of object was selected. With a supermarket product, the information could for example be: "producer", "ingredients list", and "expiration date". For a train, the information might be: "final destination", "departure time", "next stop", and "list of all stops".

Some of these points may in turn provide further details. "Ingredients" may have as subitems "vegetarian (yes/no)", "organically produced (yes/no)", and "display complete igredients list".

Actions

Some of the objects in our chatty environment will allow the user to take some action on them. One example is a train or bus allowing the user to open its nearest door. This is a well-known problem for visually impaired people, for whom it is easy to miss a bus or train because they are unable to find its doors during its brief stop at the station.

Leave traces

The user can also decide to leave virtual post-its for herself or other users on an object. These will typically be audio files reminding her of something that she noticed the last time passing by. On a traffic light, for example, one could leave the information: "Big crossroad ahead, must be crossed very quickly". Information left like this would be automatically pushed onto the user's device the next time she would pass this object again.

Our current prototype features only two options for leaving or hearing a message: leaving messages just for oneself or for anybody else, and hearing just personal messages or hearing everybody's messages. This approach obviously needs to be refined in future versions of the systems.

Take me there

By choosing this option, the user is guided to the currently described entity, e.g., for an item on a sign.

Virtual Information Boards

Sighted people orient themselves in a new and unknown environment not only by the objects they are able to see. They also learn about distant or hidden objects through signs. By mapping visual signs to audio-signs for the visually impaired, they can learn about objects not only in their immediate neighborhood, but also further away, too.

To realise this goal, signs in our chatty environment are enhanced by the same beacons used by all other objects. But instead of revealing *themselves* to the user, a sign tells her about the objects they are pointing to. By selecting one of these objects, the user can subsequently be guided there using the "Take me there" interface option.

We are currently working on integrating a navigation feature using a locally developed location system. The system relies on the signal strength of WLAN 802.11, Bluetooth and active RFID tags.

User Input

Currently, the user can only interact with the system by listening to the list of nearby objects (with support for skipping back and forth) and then choosing one of the four options described above. Future versions should also allow the user to actively search for an environment entity, either using Braille or voice input. For example, it should be possible to find a pharmacy, even if it is neither in the immediate neighbourhood, nor on a virtual signboard.

Communication Issues

There is a huge amount of data to be transferred from the environment objects to the user device. Since the tags are typically small devices with limited ressources, only the object identity, some basic information and a hyperlink is stored on the object itself. By following that link through the device's Bluetooth or WLAN 802.11 network interface, arbitrary additional information can be gathered from the wide-area computing infrastructure. Note that in case of intermittent connectivity, the world explorer's text-to-speech engine can still render the human-readable object identity stored directly on the tag (this could be aided by a dictionary in foreign-language environments).

Information Filtering and Selection

A challenging issue is choosing which information should be presented to the user. For example, when entering a shop the third time, a user might not want to receive the same information again. A similar problem arises when the user enters an area with so much information that it cannot be presented in a timely fashion. These issues of information filtering and selection are currently under investigation and will be addressed in future prototypes.

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