GuideShoes: Navigation based on musical patterns

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ABSTRACT

One of the most ubiquitous tasks we have to perform is the need to find our way to unknown destinations. We are left alone to deal with maps, ask people for directions, and understand their instructions. How can we avoid this frustrating and time-consuming process? How can we help all the people who can't or won't use printed or spoken instructions (little kids, the visually-impaired, or users occupied with other urgent tasks)?

This paper describes GuideShoes, a wearable system that uses aesthetic forms of expression for direct information delivery. This is a first tool to utilize music as an information medium and musical patterns as a means for navigation in an open space, such as a street. GuideShoes provides musical navigational cues in the background, thus reducing the problem of cognitive information overload.

The system consists of a pair of shoes, equipped with a GPS, wireless modem, MIDI synthesizer, CPU, and a base station that acts as the central unit for data processing.

Keywords
Music, emons, navigation, guidance, emotional feedback, ambient media, wearable computing.

INTRODUCTION

Information can be imprinted on species. As Konrad Lorenz showed us for animal behavior, recent cognitive development research shows that infants also start forming structured ideas very early in their life. Nowadays, a lot of research is being conducted on how imprinting a specific combination of emotions on information can enhance that information's appeal [1]. However, we often miss the simple fact that emotion by itself can be used as a self-contained information medium.

In GuideShoes, background awareness principles are incorporated into a wearable tangible interface, providing users with information regarding their travel. This is accomplished without distracting them from foreground tasks, by incorporating emotional cues, and by employing a refined system of aesthetic information fragments, called emons.

The emon approach is based on the following hypotheses:

1. Aesthetic forms can be used as direct information delivery mediums.
2. Aesthetic information can be isolated into small autonomous elements (emons).
3. Emons can be recombined to produce predictable emotional/informative responses.

RELATED WORK

Hiroshi Ishii works on related research in Tangible Interfaces. He writes, "...subconsciously, people are constantly receiving various information from the "periphery" without attending to it explicitly. If anything unusual is noticed, it immediately comes to the center of their attention" [2]. Emons can be viewed in that context as the basic elements of a new tangible approach – processed in the background, in parallel with other media sources, and reconfigurable to reflect the current state of the user and the situation outside.

Peter Meijer from Philips R&D does what he calls "Auditory Image Enhancement". His vOICe system "translates arbitrary video images from a camera into sounds. This means that you can see with your ears, whenever you want to." [3]. This approach may work well in static situations, such as in the interpretation of still pictures. However, in a dynamic open-space environment, such as a street scenario, his solution for the cognitive problem of navigation proves inefficient as it overloads the users' perception channels with vast amounts of non-filtered information.

STRUCTURE OF GUIDESHOES

The client-server interaction schematic is shown in fig. 1.

The client consists of a DGPS (Ashtech SK-8), custom-built CPU (CutBrain), spread spectrum modem (FreeWave OEM), custom-built MIDI synthesizer. (miniMIDI Boat), and RF mini-module (VCI VC1000).

The base station runs a custom-built map UI (MapTool, implemented in Tcl/Tk), with path selection features, and an emon retrieval engine (C++). It also controls the spread spectrum base station, differential beacon receiver, and an additional DGPS for detection of base station current location.

Scenario of Interaction

A user comes to the base station, picks his/her destination on the map, puts the GuideShoes and a pair of headphones on, and starts walking. An option to specify points to pass on the way, neighborhoods to avoid, etc., is available.

Depending on the correctness of the chosen direction, and compliance with the properties specified for the travel, the user hears different musical patterns that provide the necessary navigational cues, while leaving the cognitive foreground free for more creative tasks.

System Operation

Every two seconds the base station sends differential corrections to the client's DGPS, which sends the corrected current position back to the base station. These and other data exchanges are held by the spread spectrum modules on both ends. The base station processes the corrected DGPS data and, based on the correctness of the movement and other properties, retrieves and sends one of the emons from its library back to the shoes, where it is played through a wireless headphone set.

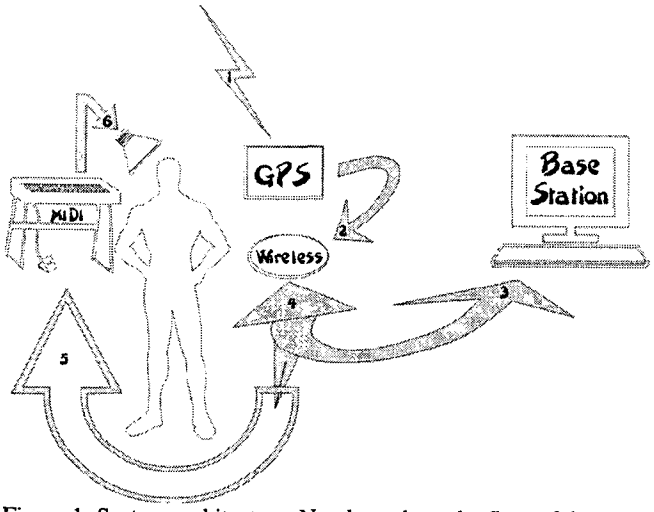

Figure 1: System architecture. Numbers show the flow of data.

Emons: Design & Testing

In order to design a valid set of emons for various life situations, we first defined criteria for their construction. Then we composed a set of emons, and started to conduct a line of user tests, using custom-written software. A brief overview of the emons' Design & Testing process follows.

Outlining the affective categories of emons

We decided to base emon categorization on the emotional model developed by Plutchik [4]. We limit our evaluation study to primary emotions: Acceptance, Anger, Anticipation, Disgust, Fear, Joy, Sorrow, and Surprise.

Creation of emons

We have created a set of 200 emons, each one being a 1-5 seconds long loop. The emons were created with no specific emotional category in mind. After recording, the emons were saved as separate MIDI file loops, to be streamed in real time upon request.

Software tool

The goal of the emons is to provide us with a navigational means as well as to enhance our awareness of the surroundings. In our testing we look at different ways of mapping emotion/music to physical spaces.

The software (fig. 2) used to test the emons, has been designed using Lingo, and additional Visual C++ modules for database access, MIDI files playback, and visual effects. Multiple clients can run simultaneously via the network, hence making the testing faster and more efficient.

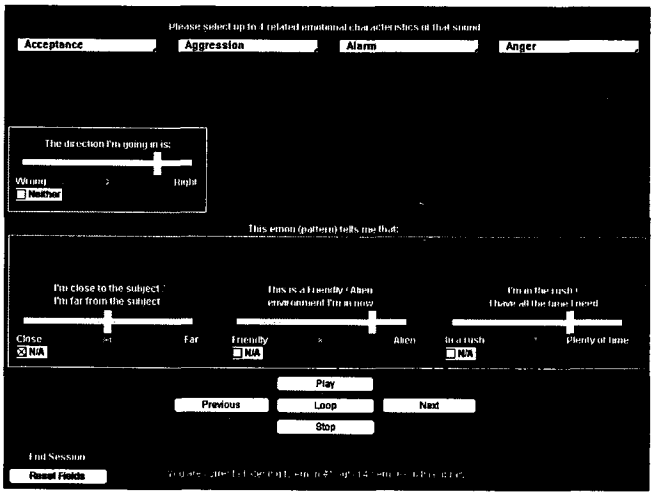

Figure 2: Emons testing tool.

Testing / Evaluation of results

A group of twenty users is being asked to provide us with representative data by filling a demographic questionnaire, and then classifying the emons into predefined categories. They do so by sequentially listening to each of the emons and selecting up to four emotional categories related to the played music, as well as rating the emon's environmental scales (as defined in software shown in Fig. 2). The test results are going to be evaluated by studying various mappings between demographic details of the user profiles and the ratings they provided for various emons.

Emons with the highest correlation scores will be used in the real system, where users will rely on the emons to get to the destination point.

FUTURE WORK

GuideShoes is a research project in progress. In the future, multiple GuideShoes clients and modes of their interaction will be developed. Issues of privacy, and emotional feedback will be further studied. Additional applications of the emon approach will be developed.

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