Position paper for the CHI 2000 Workshop on "Future Mobile Device Interfaces"
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The memory assistant: Using environmental context in future mobile device interfaces

1.!Environmental context information

In a world where more and more data is available, online or offline, from one's desk or on the move, finding ways to help humans cope and make good use of their limited attention resources is a pressing challenge. One solution we are exploring is to make use of the user's context, i.e., information about the user's situation, to present relevant information. In this position paper, we look at how we can take advantage of the user's environmental context in mobile devices interfaces in order to simplify human-device interaction. We first look at some examples of how environmental context can be used. In the second section, we describe a mobile device we envision, whose function is to help users store information and recall it based on context.

Computers are good at storing and performing quick searches on large amounts of raw data. Computer storage capacities are growing exponentially and the theoretical limits are far from being reached. Humans on the other hand have more limited storage and recall capabilities, and are good at interpreting and making sense of data. Humans also have another capability that computers are currently lacking: multi-sensory input. Whereas computers gather data from human input or from other computers, humans have a variety of ways to acquire information. The traditional description of our five senses captures only imperfectly the diversity of stimuli we are sensitive to. We are aware of environmental context information such as: where we are, who we are with, the passing of time, acceleration. Among our five senses, hearing and vision are now commonly available to desktops and laptops. The miniaturization of cameras as well as their decreasing cost lets us think that they will soon be integrated in some computing handheld devices, along with microphones. But additional sensing capabilities such as location, heat or acceleration sensing can also be added to computing devices. Even our physiological data can be made accessible to computers, although current sensors are somewhat unpractical [1]. In summary, computers could gather much more data that just user input or data from remote computers. Why would this be useful?

Human behavior is largely influenced by the context in which we evolve. Examples abound: excessive noise will lead us to raise our voice; brutal acceleration makes us reach

for a handle, etc. We also rely on environmental context as meta-data to facilitate recall. For example, we might remember that a conversation occurred in a given restaurant, with such and such friends, and that we were feeling tired, although we might not remember the full details of what was actually discussed. Although context might be of interest in desktop applications, environmental context is especially relevant when the user is mobile because several dimensions of context are susceptible to vary: location, surrounding people, travel means, speed, acceleration, etc. There are already actual examples of use of simple context information, mainly location, in mobile systems. The Palm VII handheld for instance uses location information to provide the user with local weather and traffic information or movie show times in the user's neighborhood. The Palm.net server derives the user's current zip code from the location of the wireless network's base station the user is connected to. The Palm.net gateway then uses the zip code as a parameter to query the relevant Web service. This feature both simplifies the interaction with the device by avoiding extra user input, and allows applications to present more relevant information to the user. Another promising use of context is to support human recall.

2.!The memory assistant

We envision a device whose major role would be to assist human recall. The device, called the memory assistant, is mobile, can be worn discreetly, and has very large amounts of memory. It gathers information using several sensors: camera, microphone, GPS or other location sensors, heat, acceleration, and physiological sensors are all potential candidates, provided they can be made sufficiently unobtrusive and power-efficient. It would basically capture sensor information all the time, store it, and perform simple interpretations (for example it might be able to identify faces in the video stream or transcript speech).

The basic function of the memory assistant is to allow retrieval of information relevant to the user. The user might want to get answers to questions such as:
- Who did I meet with last time I came to visit this customer?
- When was the last time I met with this person and what did we discuss?
- Remind me of what John D. Customer looks like?
- How much did the taxi to the airport cost this morning?
- Where did I put my glasses?

The user interface of such a device poses a number of interesting problems. The most relevant to this workshop deal with: interaction with the device, and context-based interaction.

An interesting requirement for the interface is that we must seek to minimize user input, since the user is mobile and can not type queries, or otherwise use a complex request interface. An obvious possibility is speech input. However, speech recognition becomes a real challenge when the user is potentially in a noisy environment, e.g., in the street or in a plane. The user could use a mobile phone to provide speech commands, assuming

Bluetooth (or similar) is used for wireless communication between the mobile phone and the memory assistant. Less obtrusive and more discreet interaction might be desirable. For output, we assume that the system's responses consist mainly of textual answers (e.g., "Your glasses are in the glove box") or visual (such as a video clip of a previous encounter with John). An interesting possibility is to conceal output devices in objects the user is already wearing. Earrings could be used to whisper in the user's ear, glasses could be fitted with small displays, and watches could be used as screens.

To simplify user interaction and in particular user input, we want to make use of the user's current context as much as possible. One idea we explore is to provide "just-in-time information", e.g., having the system whisper or display the name of a newcomer to the meeting as he shows up, or bringing up purchase history when the user arrives at the offices of a customer. Using the current context as the query constitutes context-based retrieval. A precursor system, Rhodes' remembrance agent, uses this technique to assist writing by matching the user's current typed input with a database of papers and notes [2].

The design of the memory device encompasses and blends both user interface design and more traditional human factors design. What should the device look like? How should it be worn? Can it accommodate fashion styles like glasses, watches, and to a certain extent mobile phones do?

The memory device is an envisionment of the type of mobile devices that might be possible in the future. We believe it raises interesting design interface issues due to its very nature, and that many of these issues are relevant for many kinds of future mobile devices.