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Environmental Interfaces: HomeLab

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ABSTRACT

Graphical User Interfaces (GUIs) have become the standard way in which we interact with our computers and over the years and have greatly improved our computers' usability. However, as computational power becomes increasingly ubiquitous and becomes part of the environment around us, we find ourselves reaching the useful limits of the GUI. These limits are even more pronounced in new environments like the home where many of the tasks we need to perform would be difficult, inefficient, and awkward using a GUI. In an effort to develop a natural, intuitive interface for the home, we are developing a project called HomeLab, which is an agent-based, adaptive, sensing and responding home environment. This project represents a new breed of interface called an "environmental interface." We feel environmental interfaces are more natural because they more closely resemble the physical, social "interface" humans interact with in their daily lives. Fundamentally, environmental interfaces abandon the idea of a single concentrated interface such as we might associate with a computer screen, and instead treat the whole environment (a home in our example) as the interface, seamless and immediate. Not only do appliances, screens, chairs, etc. all act as input and output devices but the house itself is a distributed system of agents responding to us. Our former notions of interfaces were narrow and centralized in space because our computers were. In the age of ubiquitous computing the interface should be distributed and ubiquitous.

Keywords

Environmental User Interfaces, User Interfaces

INTRODUCTION

Humans exist in, and were designed to interact with environments where we can touch and hold objects, hear different sounds of varying loudness coming from different directions, and see and speak to other people. Although these environments might change throughout the day (home in the morning and evenings, office during the day, and car for some amount of time between each of these) they all share certain commonalities. All of these environments are physical, multimodal, dynamic and social. In addition, there is little in the way of space localization. We do not generally need to go to specific rooms and use a specific chair to talk on the phone or use electricity. However, as unnatural as it may be, this is what is commonly required in order to use a computer. We sit in chairs facing our monitors, keyboards, and mice engaging the very forefront of our attention with room for little else, even the most trivial of tasks. Computers have gotten easier to use over time, however the current situation seems more "human-adapted" rather than "human-centered" and it is not clear whether the human or the computer adapted.

INTERFACE PROGRESSION

This adaptation first started nearly 15 years ago with the emergence of interfaces consisting primarily of graphics on a display terminal manipulated using keyboards and mice. The GUI, with its improvements in components and resources, and the transition away from “system-centered” and toward “user-centered” design methods has greatly improved the accessibility and usability of computers. (Norman and Draper, 1986) The next step in this progression is to environmental interfaces where the environment is the interface and the user exists in it. Every object, every surface, every human sense modality all can become part of the interface. Virtual reality has been dealing with how to bring peoples’ bodies into virtual worlds; environmental interfaces are the opposite. They bring the computer into human reality. In doing so, they must also reflect the same characteristics like physicality and dynamism as human environments. Given this contrast, it is reasonable to expect that environmental interfaces will be able to be created more rapidly and will be more natural next generation interfaces than virtual interfaces, since it starts with an “interface” this is already completely natural.

HOMELAB: PHYSICAL AND DYNAMIC

Most of us think little about the way we interact with our homes and the objects therein. We turn the switch on a lamp and expect it to illuminate. We turn on the radio and expect to hear music. We manipulate tangible objects, not abstractions of those objects. That is how we expect our environment to work, and as long as it does, we ignore it. Environmental interfaces maintain the ability for us to interact with physical objects by using them as input and output devices. This is critical because the consistency of our expectations is maintained. HomeLab embraces and extends these expectations by not only allowing us to interact with our physical objects, but by also learning our patterns. For instance, if a person were to sit down in a chair every evening and turn on the light above that chair over time HomeLab would recognize this as a pattern and start activating the light as soon as the person sits down in that chair. Both the chair and the light have become part of the interface. The user did not have to sit down in front of a computer and somehow indicate to the system that when they sit in a chair and it is dark in the room to turn on the light nearest the chair, as they do in many "integrated" home automation systems today. The user only had to do what they normally were doing while the environment learned about them and adapted itself to them.

HOMELAB: HUMAN AND SOCIAL

In our environments, we often use more than simple physical interactions. Humans, being naturally social, also interact with each other verbally. Likewise, HomeLab has a language element. It can understand limited phrases and can speak. This provides an ability for limited, but important interaction. Much like a small child, HomeLab cannot converse, but can answer some questions and can take direction. For instance, we are working on the ability to ask HomeLab if a specific family member is home when we enter the house or to notify us when they arrive home. HomeLab will respond in speech, just like another member of the family. We are also building into HomeLab an understanding of social etiquette and interaction rules. If it has something to say to someone, it will not interrupt a conversation, but rather wait for an appropriate pause before it interjects.

HOMELAB: MULTIMODAL

Another important aspect of our environments is that we rarely interact in a single modality. When we come home from work we speak to the other members of our families, turn on the television to watch or pick up the newspaper to read, and help prepare the evening meal. Speech and speech comprehension, gestures, vision, etc. are all being utilized. Because of this, environmental interfaces must also readily handle several modalities at once and be able to leverage the extra information each modality is conveying. For instance, assume we are preparing for a vacation want certain lights turned on in the evening in order to give the illusion of the home being occupied. We would simply take that person who will be coming by to feed the pets and water the plants into the room and show them which lamp needed to be activated and tell them at what time. Similarly, HomeLab can be taught in the same manner by simply walking into the room and turning on the light while saying, “Do this every night at seven”. HomeLab, in keeping with its social design, will respond by saying “Ok, got it! I am going to do this <it turns on the light again> every night at seven,” again just like another member of the family.

CONCLUSION

The age of the GUI is over. With the advent of ubiquitous computing, we have an opportunity to create a much more natural interface: the environmental interface. The GUI changed the face of computing and made it an everyday occurrence. Surely environmental interfaces, with their great reach, will gain even more ubiquity and have an even deeper effect on every moment of our lives. Ironically, if environmental interfaces truly live up to their potential we may never again notice we are using computers.

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