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LETTERS TO THE EDITOR



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The Advanced Computing Systems Association &
The System Administrators Guild

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TO RIK FARROW

FROM DR. MARTIN HERMAN

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I read your article "Musings on Embedded Systems" that appeared in the July 2000 *login:* and enjoyed it very much. In the article, you gave a description of Smart Spaces that was focused around the concept of a wireless island. However, the concept of Smart Spaces as generally used has a broader definition that also includes natural human-computer interaction and intelligent access to information that allows people to achieve their tasks more efficiently. The purpose of this letter is to present this alternative point of view.

I view a Smart Space as a work space embedded with computers, information appliances, and multi-modal sensors that allow people to work efficiently, together or individually, through unprecedented access to information and help from computers. Smart Spaces support sta-

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tionary and mobile information environments that may be connected to the Internet. A Smart Space has the following characteristics:

1. It may perceive and identify users and their actions and goals.
2. It may use speech, natural language, computer vision, and other perceptual user interfaces.
3. It provides interaction with information-rich sources.
4. It enables devices carried or worn into the space to be easily integrated with the devices present in the space. (This characteristic is closely related to your description focusing on a "wireless island.")
5. It provides extensive information-presentation capabilities.
6. It understands and anticipates user needs during task performance.
7. It provides for distributed and local collaboration, including collaboration with field personnel and mobile workers.
8. It provides improved memory and summaries of activities and deliberations for later use.

NIST is developing the Smart Space Modular Testbed based on these concepts. The testbed is currently a room which contains several video cameras, several microphones including a microphone array (for understanding speech when the speaker stands at a distance from the array), a stereo camera system, and other sensors. The testbed will demonstrate integration of multi-modal sensors with multiple applications (e.g., speech processing, speaker recognition, image/stereo processing, face/gesture recognition, information retrieval), as well as integration of wireless mobile devices and sensors.

The testbed also provides a defined middleware API for realtime data transport, a connection broker server for sensor data sources, and processing data sinks. For example, a microphone array

acquires a speech signal, reduces it to a single channel, and offers it as a data-flow. Then a speaker-identification system subscribes to the signal flow, while a speaker-dependent speech-recognition system subscribes as well. The speaker identification system then offers a real-time flow, to which the speech-recognition system subscribes. This layer makes it easier to integrate components that were not intentionally designed to work together, such as speaker identification and speech recognition systems. The data transport mechanism is also extremely lightweight and allows high throughput rates.

The goals of the project are to:

1. Develop metrics, tests, and standards to push forward underlying Smart Space technologies.
2. Develop test data and test scenarios/tasks.
3. Provide impartial, large-scale evaluations across many different systems and organizations.
4. Develop interoperability specifications and test methods.
5. Develop and distribute an integration architecture that provides the infrastructure for integrating multiple sensors, computers, and applications.
6. Provide a modular testbed for integration of component technologies. This (a) permits integration of components from different vendors, (b) permits performance evaluation of end-to-end systems, (c) permits data collection with end-to-end systems, and (d) permits testing of interoperability of components.

Please visit our Web site
<<http://www.nist.gov/smartspace>> for more information.