

MEMS Frontier Devices

“Blue Devices” That Provide Comfort, Safety and Security

Yoshiro Mita, Associate Professor of Electrical Engineering, Graduate School of Engineering, The University of Tokyo

On a recent business trip to France, I wrote an essay about the fact that, up until around 20 years ago, the United States and Europe had seemed very far away. At that time, one of my former teachers was living in the United States on a long-term basis. He told me that, hungry for things written in the Japanese language, he had read and reread all of the books that he had brought with him, even those that he would not ordinarily read. The physical distance of around 10,000 kilometers between the United States and Japan has not changed. But now, even when we go to the other side of the world, we do not feel that we are very far away. The reason, of course, is the dramatic progress in cellular telephones and the means of transmitting information typified by the Internet. Now, wherever you are in the world, there is an infrastructure in place that allows you to “connect.” We have entered an age in which, using the same cell phone you use at home, you can easily communicate with friends and family wherever you are.

Even while I was writing these words, however, I was excited and fidgety and unable to calm myself. The reason was simple. During the summer I had been in France away from my family in Japan, and I knew that tonight I would be reunited with my wife and eight-month-old son for the first time in 40 days. (I know that in Japan it is forbidden to bring up one's family in speeches of this kind, so I would ask you to apply the European standard and forgive me.) Naturally my wife and I called one another on the phone frequently, and in the background I could hear my son's voice. But telephones do not transmit the feel of the skin and the warmth of the body, so it is different from actually being there. When you think about it, the information and telecommunications technologies of the 20th century were successful at transmitting information over long distances for only two of the five senses: seeing and hearing. Even though we are now in our seventh year of the 21st century, the transmission of information for the other three senses – smell, taste and touch – has not yet become viable. If we were successful in transmitting these three senses, it would enable communication with a greater sense of actually being there. Things would change from “home is so far away” to “home is always nearby,” and it would undoubtedly have a revolutionary impact on society.

In order for “blue devices” to enable people to have more comfortable, more human lives, they must aim to create not only sensors and actuators capable of transmitting information for all five senses (not merely video and audio) but also “sixth sense” devices – devices that offer not second sight or the “six senses” of Buddhism (the five senses + innermost feelings or “heart”) but that sense physical and chemical quantities that cannot be detected with the five senses available to human beings, such as imaging by means of infrared rays and terahertz waves.

Naturally, the applications for these devices would not be limited only to the transmission of information. They could also serve as “food security” devices: through the use of sheet-like tags that record changes in temperature and humidity, they could be used to ensure that the environment for gourmet food items has been properly controlled, and guarantee the quality of food not by means of mechanical “sell-by” dates but by monitoring the food itself for damage and determining the date by when it should be consumed. Or they could be used as “caregiver” devices for in-home care use, detecting changes in vital signs and out-of-the-ordinary behavior and other abnormalities and issuing alerts on the network. The expected development of these and other devices in the future will help to ensure both safety and peace of mind. (Fig. 1)

As shown in Fig. 2, there will be three mounting modes for blue devices: tag type, mobile device type and large-area sheet type. Each type will be used where its features are most appropriate.

- **Tag type:** Supermarket price tags or smaller configurations. As in the example of the food security device, these will be attached to an object and will keep records over a long period of time.

- **Mobile device:** Similar to present-day cellular telephones. The components in cellular telephones will continue to become smaller and smaller with each new generation. However, from the standpoint of usability, the terminal itself cannot get any smaller. Accordingly, “blue devices” will be integrated into the vacant space to function as “five sense” transmission devices.

- **Large-area sheet type:** Devices will be integrated into posters or other display objects, or the poster itself will be an electronic device. These devices will be used to

create moving life-sized posters or signs that offer simultaneous interpretation services.

The technical issues common to all of these devices are twofold: how to achieve the necessary degree of miniaturization, and how to create large-area screens. More specifically, the following are thought to be essential:

- Commodification of high-end devices, reducing costs, achieving ease of assembly
- Achieving large-area sheets, thinness and flexibility
- Chemical applications for three-dimensional nanostructures

The following research and development topics will be particularly important from this point on:

- Technologies to integrate microcomponents over a large poster-sized area
- Technologies that simplify assembly by completing a circuit simply by using a sealing procedure to align and attach modules (Technology that simplifies assembly processes (for example, configuring circuits by sticking modules together in the same manner as using adhesive tape to attach things to one another)
- Chemical applications for three-dimensional nanostructures that use the principle that the ratio of surface area to volume increases when an object is made three-dimensional

In any age, what is most important is to create a world in which communication between people is smoother, and in which people can live with one another in peace and harmony. This is why I eagerly await the day that “blue devices” can play an important role in creating comfortable lifestyles and a peaceful and safe society thanks to communications utilizing all five senses.



Fig. 1 “Blue devices” have many different applications, from information transmission to historical monitoring to information-provision.

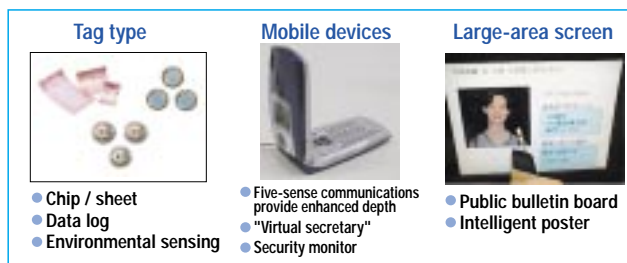


Fig. 2 Three modes for “blue device” mounting

Table 1 “Blue Device” Working Group Members (in no particular order)

Yoshio Mita	The University of Tokyo
Masakazu Sugiyama	The University of Tokyo
Takao Someya	The University of Tokyo
Masafumi Kimata	Ritsumeikan University
Susumu Sugiyama	Ritsumeikan University
Masaaki Ichiki	National Institute of Advanced Industrial Science and Technology (AIST)
Masayoshi Higuchi	Omron Corporation
Yuji Saisho	Matsushita Electric Works, Ltd.
Yasuro Irie	Mizuho Information & Research Institute, Inc.
Shin'ichi Izuo	Mitsubishi Electric Corporation
Takaaki Hirata	Yokogawa Electric Corporation