

Electronic Doctor's Bag: A mobile communications system for home-visit medical services to overcome shortage of doctors and regional healthcare disparity



Professor Makoto Yoshizawa

Research Division on Advanced Information Technology, Research and Development Divisions, Cyberscience Center

Completed the last half of the doctoral course of the School of Engineering, Tohoku University in 1978. Ph.D. in engineering. Worked as Research Associate and then Associate Professor at the Faculty of Engineering, Tohoku University. Then, assumed the positions of Associate Professor at the Faculty of Engineering, Toyohashi University of Technology, and then, Associate Professor at the Graduate School of Information Science, Tohoku University. Appointed as Professor at the Information Synergy Center, Tohoku University in 2006, and then, at the Cyberscience Center in 2008. Worked as Visiting Researcher at the Johns Hopkins Medical Institution of Medicine, Baylor College of Medicine, in 1999. Also a member of the Society of Instrument and Control Engineers, a member of Japanese Society for Medical and Biological Engineering, and an advisory committee member of IEEE Engineering in Medicine and Biology Society.

<http://www.yoshizawa.ecei.tohoku.ac.jp/>

In Japan, regional health disparity is getting larger and larger. Many central hospitals in rural areas are short of doctors. Applications of information and communication technology (ICT) in the medical field are drawing attention as they may be effective for solving those problems.

Professor Makoto Yoshizawa and his colleagues set up the Consortium for Medical Information Communication Systems in the Mobile Environment, together with Professor Tomoyuki Yambe of the Institute of Development, Aging and Cancer, and concerned business enterprises, in 2009. Then they undertook the development of a mobile health check system, called the "Electronic Doctor's Bag," that takes advantage of a mobile communication system to easily transmit not only sounds and high-quality video images but also biological information such as an electrocardiography (ECG) and blood pressure data. Its features are broadly as follows:

- 1) With encrypted communication of high-quality video images, sounds and biological information, remote medical practice is made possible with almost the same security as face-to-face medical practice.
- 2) Applicable via mobile communication systems (PHS and mobile phone), in other words, in places without Internet lines (e.g., patients' homes, ambulance car, site of disaster, etc.)
- 3) Makes it possible to combine bio-measurement terminals without restrictions, and thus, can be operated flexibly according to the purpose, e.g., home medicine, fast aid treatment, and health care.
- 4) Enables electronic control of patient data.

An Electronic Doctor's Bag contains communication equipment including a PC, video camera and mobile phone, and medical equipment including an ultrasonography, blood pressure meter, and ECG, and can be easily carried. The intended usage scenario is that a nurse visits a patient's home, carrying this Bag, and takes an ECG graph and measures blood pressure, communicating with a doctor at a hospital and transmitting the medical information to the doctor by means of ICT. Thus, it is designed to achieve a virtual environment for face-to-face medical practice through a video camera.

This will make it possible for medical institutions to cover many more patients in areas with a scarce number of doctors. For emergency medical care, it will allow for emergency medical technicians to send measurement data on a patient to doctors, and thereby obtain an exact and quick diagnosis from them.

This system is expected to play a great role in medical practice in rural areas or on disaster sites once necessary legal arrangements and cooperation with medical institutions are put in place. This work was supported by the Sendai Area Knowledge Cluster Initiative founded by the Japanese Ministry of Education, Science, Sports and Culture.



Images are highly compressed, while maintaining high definition, so that a doctor at a distance from a patient can check the patient's face complexion, presence of skin diseases, edema, actions, way of walking, etc. In addition, diagnostic data is encrypted to prevent any leak of a patient's personal information, and transmitted to doctors at a hospital/clinic via a PHS or a mobile phone.



A nurse sends biological information on a patient to a doctor at a medical institution. Necessary measurements are made by means of the biological measuring terminals (an electrocardiography, blood pressure meter, ultrasonography, etc.) according to the type of disease. The obtained measurement data is stored in a USB memory card or the main unit of the Bag via wireless LAN, and thus, it can be encrypted and transmitted to the medical institution by extremely simple operations.



The Electronic Doctor's Bag contains a PC, video camera, mobile phone, ultrasonography, blood pressure meter, ECG, etc. It is expected to use a tablet-shaped PC such as the iPad.



Members of Yoshizawa Laboratory. Their fields of research widely range from artificial hearts, to virtual reality, to biomedical control engineering



My favorite

Karaoke is the best stress relief for Prof. Yoshizawa. His favorite song is *Hymne a l'amour*. He has a large repertoire of songs. His nice singing voice is well known to the members of his laboratory. He also works as a coordinator for the Tohoku University Science Café.

Revealing an "unknown interaction of molecules" using surface forces measurement



Professor Kazue Kurihara

Interface PhysChem Laboratory, Soft Materials Group, Advanced Institute for Materials Research (WPI-AMIR), and Nano-surface Chemistry, Measurement Research Division, Institute of Multidisciplinary Research for Advanced Materials

Born in Tokyo in 1951. Completed the doctoral course, Department of Industrial Chemistry, School of Engineering, University of Tokyo. Ph.D. in engineering. Worked as Technical Assistant at the University of Tokyo, then a postdoctoral fellow at the Department of Chemistry, Texas A&M University, a postdoctoral fellow at the Department of Chemistry, Clarkson University, a researcher at the Research Institute for Production Development, Visiting Researcher at the Institute for Surface Chemistry, Group Leader at the Research Development Corporation of Japan. Appointed Associate Professor at the Department of Applied Physics, School of Engineering, Nagoya University. Appointed Professor at the Institute for Chemical Reaction Science, Tohoku University, in 1997, and at the Institute of Multidisciplinary Research for Advanced Materials, reorganized from the former Institute in April 2001. Has been in current position since 2010.

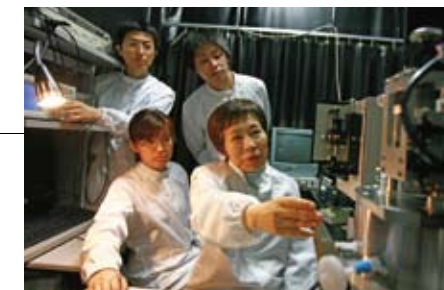
<http://www.tagen.tohoku.ac.jp/labo/kurihara/index.html>

Interactions like attraction and repulsion between magnets also exist between molecules. These intermolecular interactions are an area of study for Professor Kurihara and the members of her laboratory. The measurement of intermolecular surface forces, among others, is the main matter that they are dealing with. In other words, they are measuring the distances and forces with which such interactions occur among various molecules. Resulting measured values can be a key to understanding specific intermolecular interactions.

This area of measurement of surface forces deals with extremely small objects observed on the nanometer scale in research. Thus, the measurement requires extremely high precision, and this area of research is full of challenges, including maintenance and improvement of research facilities. Not many researchers have chosen this area for their work. Under these circumstances, Professor Kurihara and the members of her laboratory have developed new approaches and new apparatus by themselves. A lot of apparatuses that they have developed are viewed with keen interest by other researchers in the same field.

Some interactions among molecules exist close to you. For example, the light or moist sensation of lotion, or a mechanism to increase the viscosity of a sealing material used in buildings, are attributed to a micellar aggregate of surfactant that easily deforms, or interactions that occur among liquid molecules. It is interesting that the process of elucidating an unknown world on the nano scale leads to discoveries and advances in areas of daily life. In fact, their laboratory has often received unanticipated inquiries from businesses.

One of their future research themes is interactions among liquid molecules, which are mostly unknown. Furthermore, they are considering developing a new apparatus that integrates electrochemistry and optical engineering to increase research possibilities.



Prof. Kurihara and the members of the Nano Surface Chemistry Laboratory. They are cheerful and lighthearted in spite of the fact that they engage in work in a severe area where extremely high precision is required more than anything. In this laboratory, every day measurements take place to elucidate an extremely small world scaled in nanometers.



The twin-path surface forces apparatus, among others, that Professor Kurihara *et al.*, have developed attract the most attention. This apparatus is rated highly because it can be applied to materials close to our daily life. It is easy to use for surface forces measurements, which have so far taken place in a special, distant world performed only with transparent samples. It enables the application of these measurements to general uses.



A surface forces apparatus is fully disassembled and stored immersed in ethanol each time it is used, in order to prevent even extremely small particles of dust from entering, which could damage its precision.



My favorite

Prof. Kurihara often works at a PC for several hours. She stretches with a balance ball every two or three hours. The space for stretching is at the back of the table, and cannot be seen from the doorway. Thus, she sometimes surprises students who come to this room because she is "audible but invisible."

