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Feature

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Contribution of Informatics to the Games

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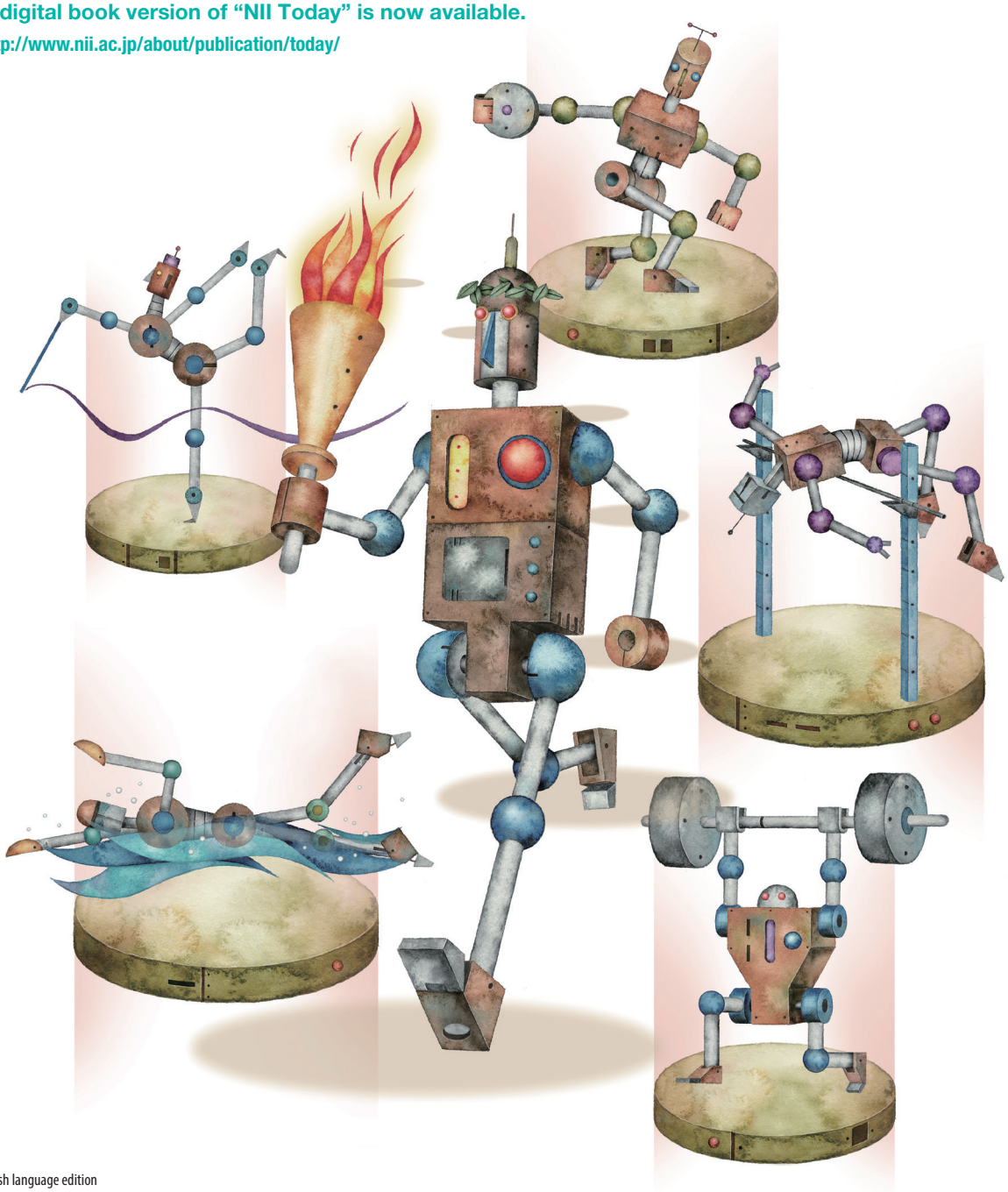

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NII Interview

Innovation from Diversity: The Paralympics are Key

The 2020 Olympic and Paralympic Games, which are set to be held in Tokyo (hereinafter, Tokyo 2020), present the perfect opportunity to consider how ICT can help people enjoy sports and enrich society. NII's Director General, Masaru Kitsuregawa, states that the Paralympics in particular will trigger innovation through efforts to resolve the problems faced by disabled or elderly members of society. We discussed attitudes toward "diversity"—something that is also of importance in NII's research and development.

Yamamoto: As the head of NII, what is your interest in Tokyo 2020?

Kitsuregawa: The nation's interest is, of course, focused primarily on the Olympics, but I would like to shine the spotlight on the Paralympics. The Paralympics are a great opportunity to build a society in Japan that facilitates the activities of people who are disabled or elderly. If foreigners who visit Japan to watch the Games get the impression that Japan is an easy place for people with disabilities and the elderly to live, then that message will reach across the globe. Every country will eventually face the "graying" of their population, and Japan is at the forefront as the nation with the highest rate of aging in the world. Pioneering an approach to this issue should be considered to be a major challenge for humankind. I feel that this issue is a potential source of innovation, in the same way as support for people with disabilities triggered the development of the touch screen.

Yamamoto: Could you give us an example of R&D being carried out at NII to support people with disabilities?

Kitsuregawa: "Voice bank technology" using speech synthesis. This technology "stores" the voices of patients with diseases such as amyotrophic lateral sclerosis (ALS) who gradually lose the ability to speak as their throat muscles weaken, and when a patient has lost the

Masaru Kitsuregawa
Director General, National Institute of Informatics (NII)

ability, it reproduces their own voice using synthesized speech.
We also have explored a technology that supports sign language communication. The ultimate goal is to achieve a level of usability so that, when a television program is being filmed and the system is placed beside a person speaking, the sign language images appear automatically.
It is not necessary to focus on NII's private initiatives when considering methods of development. "Crowdsourcing"—in which large numbers of people join forces to accomplish something—is appropriate in the case of barrier-free maps and guidance systems available to people with disabilities, the elderly, and people with young children. Creating these things from the top down is too expensive, and the overlap with social security where we help one another is in step with the times.

Yamamoto: Considering the hugeness of Tokyo, both spatially and temporally, what kind of new technologies can we expect to see implemented during the Tokyo 2020 Games as a whole?

Kitsuregawa: It is easy to imagine that most visitors and spectators at the Games will be using smartphones. Tokyo 2020 will make use of existing facilities dotted around Tokyo, and so I expect that frequent use will be made of smartphones for traveling between venues, as well as for event programs, notification of event results, event guidance, and so on. Immediately after the end of the London Olympics, a parade for Japan's medalists was held in Ginza, Tokyo, and a crowd of 500,000 people attended this 20-minute event. Pedestrian flow analysis employing ICT will play an extremely important role in easing congestion and ensuring safety.
One unique and promising area of R&D which NII is also involved in is technology for dealing with garbage. Enormous volumes of garbage are expected, but the number of spectators will be different for each event, so the output of garbage will also change. This means that garbage collection along predetermined routes will be insufficient. Therefore, the efficiency of garbage collections will be improved by installing sensors in each garbage can that allow it to say, "I'm full." This is part of the Internet of Things (IoT) that has attracted much attention in recent years. I think that similar ideas for controlling objects by linking them to the Internet will be implemented all over the place.
The negative aspects of ICT must also be acknowledged. There was a flood of cyber attacks during the London Olympics. Even if systems are strengthened within Japan, it will be difficult to make them completely secure, partly because holes will be created by computers brought into the country by foreign journalists. Terrorism in the physical environment is also a major issue, and the difficulty of providing completely closed spaces in urban areas is troubling.

Yamamoto: In terms of affinity between sports and informatics, and in terms of "communication tools", it seems that the attitude of the people involved will be important in some aspects, won't it?

Kitsuregawa: The Paralympics are said to be completely different from the Olympics in terms of the atmosphere at the events. For example, in wheelchair basketball, the sudden braking and sharp turns cause the wheelchair tires to scorch and give off a distinctive smell. The enthusiasm of the athletes appeals directly to the senses of the people watching. I am sure that everyone watches and wonders whether there is anything that they can do to help.
At the Paralympics, where people with disabilities become athletes, the mindset will be to try to create a new and fascinating Games without getting caught up in stereotypes. In fact, while the number of Olympic events is about 300, the number of events in the Paralympics is about 500. As researchers, we want to respect the idea of creating a Games and a social environment that a greater diversity of people with disabilities can enjoy.

Yamamoto: Nowadays, corporations are endeavoring to make use of women, people with disabilities, and foreigners in order to draw out perspectives that have been lacking in the past.

Kitsuregawa: Diversity is extremely important in thinking about developing innovations with a different mindset. Considering the needs of people with disabilities and other minority groups is a great catalyst. Sumo is a popular sport in Japan, whereas cricket is still popular in England. Things cannot be judged by one standard. The term "long tail" generated by diversity is challenging and extremely interesting to researchers.
ICT rivals natural human power: for example, artificial leg technology has already led to people with disabilities being able to run faster than able-bodied people. It may seem strange, but it is exciting that a person with a disability can have that level of activity. Innovation truly comes from the desire to overcome challenges.

A Word from the Interviewer

When considering sports and science and technology, Director General Kitsuregawa started by visualizing a target: a society that is rich and rewarding for the elderly and people with disabilities. ICT is clearly a needs-oriented tool for reaching this target. During the interview, Director General Kitsuregawa described various dreams adding, "The detailed plans aren't settled yet, but...." I have high hopes for NII's collective power to imagine the future.

Kayoko Yamamoto
Nikkan Kogyo Shimbun, Ltd.

Editorial Writer, and Senior Staff Writer in Science and Technology Division

Graduated from the Faculty of Science, Ochanomizu University, and completed a master's degree at the Tokyo Institute of Technology. Joined the Nikkan Kogyo Shimbun, Ltd. in 1990, covering science and technology, business, university-industry partnerships, and science and technology administration. Completed a doctorate at the Tokyo University of Agriculture and Technology in 2011, focusing on communication in industry-academia-government collaborations. In the same year, received an award from the Japan Society for Intellectual Production for her achievements. Works as a part-time lecturer at three universities, including the Tokyo Institute of Technology. Ad hoc member of the Ministry of Education, Culture, Sports, Science and Technology's Council for Science and Technology. Author of "How to Use Communication Media to Increase Research Funding" and "A Guide to Job Hunting for Science Majors" (Maruzen Publishing Co.).

Using Mobile Sensing to Understand Issues Related to Foreign Tourists

Helping to promote tourism, looking ahead to Tokyo 2020

Much attention is currently being paid to mobile sensing, which detects people's movements and surroundings through the smartphones or other devices that they are carrying with them. Research has already begun into capturing the behavior of domestic and foreign tourists in Japan from data acquired through mobile sensing and using it to promote tourism. Kenro Aihara, an associate professor at NII involved in this research, describes the details, current state, and future of the research, focusing on the Olympic and Paralympic Games.

Turning sensing data into social value

Smartphones are ubiquitous nowadays. These devices can be regarded as bundles of sensors that detect not only location information but also the orientation and motion of the user via acceleration sensors. The microphone and camera are also types of sensors. A smartphone is usually used by a specific individual, and so the movements and surroundings of the owner can be understood from the data obtained via the sensors. This is called mobile sensing. However, information acquired from mobile sensing involves issues of privacy, and so it is necessary to create a framework that gives the user some benefit in exchange for providing data. The user makes use of services that incorporate this framework, data are acquired, and this leads to social value and personal benefit for the user. I consider mobile sensing to involve implementing a cycle of data acquisition, which includes creating this kind of framework.

Kenro Aihara
Associate Professor, Digital Content and Media Sciences Research Division, National Institute of Informatics
Associate Professor, Department of Informatics, School of Multidisciplinary Sciences, The Graduate University for Advanced Studies

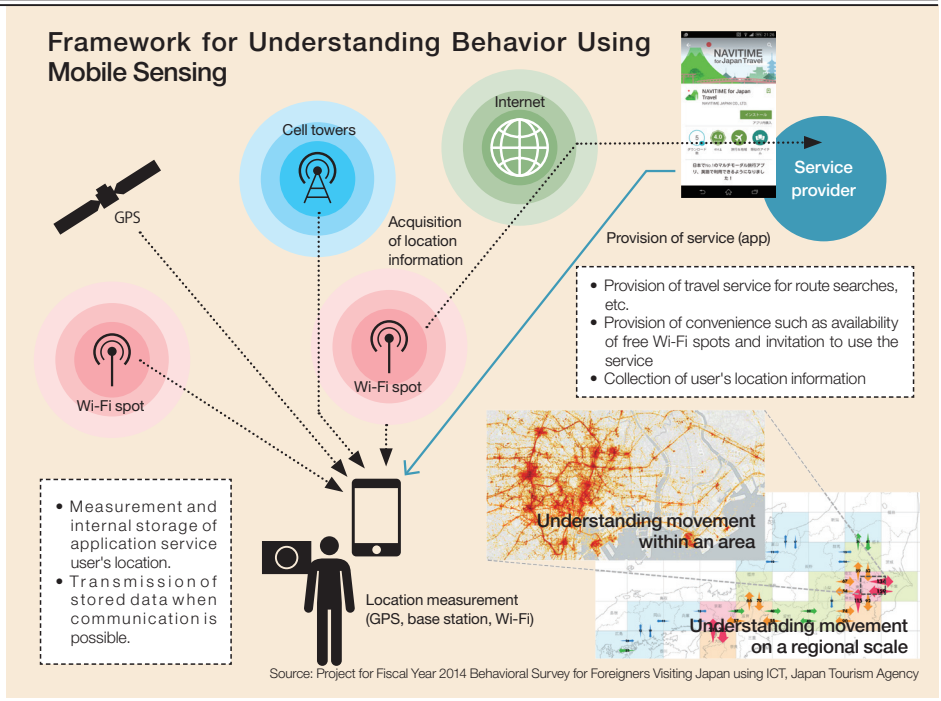
We are currently conducting a behavioral survey of foreign tourists using mobile sensing with the Japan Tourism Agency, and this survey also involves a mobile sensing framework incorporated within services.

Surveys have shown that foreign tourists are dissatisfied with the low availability of wireless LAN access points. Users must have an incentive to cooperate by providing data while using a service, and if using a certain application means that the number of free Wi-Fi spots available will increase, foreign tourists may be motivated to use that application. Our current behavioral survey therefore incorporates a data collection framework into such an application.

The survey requires sufficient user participation. When we looked into the applications frequently used by foreign tourists, we found that travel applications that perform route searches are popular. We therefore incorporated a data collection framework into a travel application "NAVITIME for Japan Travel" by NAVITIME Japan Co., Ltd. and began a pre-study at the end of October 2014. In less than one month, we had approximately 30,000 downloads, and of these, we were able to obtain user

registration data from about 10,000 people. Over the course of a year, this should amount to more than 100,000 people—equivalent to 1% of Japan's 13 million foreign tourists per year—and the survey will be feasible. We hope to further increase this number to make the behavior of foreign tourists more clearly visible.

The people who consented to data collection were asked to enter attribute information on sex, age, and country/region. After the methodology for analyzing this information has been verified, the project will finally begin from fiscal year 2015. We are also examining the use of other applications aimed at foreigners to allow wider collection of information in the future.



Source: Project for Fiscal Year 2014 Behavioral Survey for Foreigners Visiting Japan using ICT, Japan Tourism Agency

What can be found using behavioral surveys, and how can it be applied?

Behavioral surveys provide various types of information. From a macro perspective, it is possible to gain an overview of the travel routes of foreign tourists within the country. For example, it has been found that tourist movements are concentrated on tourist sites along the so-called "golden route" between Tokyo and Kyoto. By analyzing the information in detail, tourist behavior according to country and age can also be understood, leading to matching between visiting tourists and the parties receiving the tourists. For example, foreigners might visit a particular tourist spot, but unless they are aware of information on the surrounding area, they may return home without making any excursions into the surroundings. Through appropriate delivery of appealing information on the surrounding area, both the tourists and the parties receiving the tourists will avoid missing out on good opportunities. I hope that local people will make effective use of the information obtained from behavioral surveys.

On the other hand, from a micro perspective, it is possible to understand the detailed movements of tourists. If we can gain such information as where tourists go after heading to Asakusa from the Skytree, or what the differences are in attributes between people who walk along Asakusa's main street and those of people who walk along the back streets, it may be possible to use the results in urban development.

By including regional information in services, it may also be possible to alter people's behavior. For example, if a tourist in Kanda wants to eat some good, cheap food, then a framework that pinpoints and communicates restaurants recommended by locals can be used to make a well-founded matching, which could also allow diversification of tourist movements.

Attractive regional development using sensing data

With the aim of making Japan a tourist destination, the Japanese government has set a target of 20 million foreign visitors per year. Tokyo's hosting of the 2020 Olympic Games was decided against this backdrop, and the Games are an ideal opportunity to show that Japan is a safe country with a wealth of fascinating tourist attractions. Before the Games, we need to establish a methodology for understanding the movements of foreign tourists in Japan and then accumulate know-how for using that data so that local governments can apply the methodology in order to construct a system for improving the reception of foreign tourists.

Further, by superimposing various other types of information not obtained via mobile sensing, such as SNS posts and rental car travel routes, we intend to gain an understanding of tourist routes and motives. This will allow us to create a system that can be used to establish more attractive tourist routes and create a system for receiving tourists.

Crowds are expected to concentrate in certain places during the Olympics and Paralympics, to which we will respond by providing services for preventing disasters and reducing risk using mobile sensing. However, the Olympics and Paralympics are just one point along the path of development of this technology. Looking to the future, I hope that by providing information services that are helpful to users, mobile sensing will contribute to the development of attractive regions by, for example, prompting changes in people's behavior by connecting towns and people, and creating new business opportunities through effective use of resources.

(Interview/Report by Yuko Sakurai)

NII Special

2

System Concept for Rehabilitation of Phantom Limb Pain

Using Immersive Virtual Reality in Rehabilitation

The sensation that a missing limb is still attached to one's body is known as "phantom limb". This feeling differs from person to person: in some cases, the patient can subjectively move the limb, whereas in other cases they cannot. "Phantom limb pain" refers specifically to when a patient feels pain from the phantom limb. In the summer of 2014, Tetsunari Inamura, an associate professor at NII who researches human-robot interaction, became fully involved in a collaborative project into rehabilitation of phantom limb pain using virtual reality (VR) as part of a Grant-in-Aid for Scientific Research on Innovative Areas entitled "Understanding brain plasticity on body representations to promote their adaptive functions."

Using VR to treat phantom limb pain

Phantom limb pain is pain that is felt to come from a missing limb. Such pain cannot be cured using ordinary treatments, because the limb does not actually exist.

The American neuroscientist Vilayanur S. Ramachandran and others have succeeded in relieving phantom limb pain through a technique that uses a mirror box. The patient places their good limb into the box and the mirrors inside the box reflect an image of the good limb onto the phantom limb side. When the patient moves their good limb, the reflected image makes it appear as though the patient is also moving the phantom limb, which it is claimed can relieve pain in the phantom limb. This effect is attributed to rebuilding of the body image in the brain as a result of visual feedback. In addition to rehabilitation of phantom limb pain, and mirror boxes are used in treatment for hemiplegia.

There are, however, drawbacks to this method. Because it is based on using mirrors, only symmetrical movements can be made. Also, cases of phantom limb are diverse: for example, some people imagine their phantom limb not as an ordinary arm, but as a hand growing from the tip of their shoulder. So the cases that the mirror box method can be applied are limited.

However, if visual images are provided using VR, arbitrary movement of a phantom limb is possible. Further, using VR makes it possible to present an image of the phantom limb that resembles original limb that the patient subjectively is feeling.

The system developed by Associate Professor Inamura with a team that includes Professor Shinichi Izumi of Tohoku University. Wearing an immersive head-mounted display, the patient moves their good arm and a CG arm appears and moves on the missing arm side.

Exploring body representation in the brain through treatment of phantom limb pain

Associate Professor Inamura is working in collaboration with a team that includes Professor Shinichi Izumi, an expert in clinical rehabilitation engineering at the Graduate School of Biomedical Engineering, Tohoku University. In the system under development, the patient wears an immersive head-mounted display, and when they move their good arm, a CG arm appears and moves on the missing arm side. The arm is CG, so it can be tailored to the patient and the rehabilitation program. The researchers have succeeded in building a system capable of displaying a phantom limb resembling the limb that the patient subjectively feels using CG, and they are now at the stage of basic testing.

The system currently uses simple depth sensors to recognize gestures, but the researchers plan to achieve more realistic movements using motion capture system

Tetsunari Inamura

Associate Professor, Principles of Informatics Research Division, National Institute of Informatics
Associate Professor, Department of Informatics, School of Multidisciplinary Sciences, The Graduate University for Advanced Studies

capable of measuring movements with high accuracy in the future. They also intend to expand the system so that it can accommodate not only arms but also the lower body. Their aim is to have finished clinical trials and be able to actually apply the system in rehabilitation within 5 years.

The purpose of this system goes beyond rehabilitation to the exploration of body representation in the brain.

"We are investigating what kind of sensory information influences sense of ownership of one's body and sense of agency, and what mechanisms create and change the body representation in the brain."

A sense of agency is the feeling that one is executing one's own bodily movements. This feeling is considered to be closely related to body representation, and one starting point for exploring this relationship is phantom limb, where the patient can feel and move a missing limb. For this reason, the system under development allows changes to the timing of movements. A delay on the order of between approximately 0.3 and 0.5 seconds appears to produce a sense of discomfort, but if the timing is right, the patient feels a sense of agency, even if the displayed appearance of the phantom limb is quite strange. In the future, the researchers plan to investigate the mechanism for this by also measuring what is happening in the brain.

Hopes for widespread application —from rehabilitation to sports training

Other systems for performing rehabilitation using VR have previously been built. One feature of the system under development now by Associate Professor Inamura and the rest of the team is its use of SIGVerseTM, a sociointelligenesis simulator. SIGVerse is a server-client system capable of "incorporating all rehabilitation data as big data".

In conventional rehabilitation, some areas are left to the experience and intuition of the physiotherapist, but this means that the rehabilitation is limited by the skill of the physiotherapist. Associate Professor Inamura was interested in the possibility of implementing a system that could objectively integrate data on what scores were obtained by patients doing what movements and when.

"If all of the relationships showing what movements patients managed when they were shown what images are collected together, qualitative differences will appear. I am convinced that it will be possible to extract relationships using big data analysis and machine learning."

The question of how best to manage the log is "for the future", says Associate Professor Inamura, but he also says, "I want to help in some way towards collecting and systematizing the information that is currently hidden away inside the heads of therapists."

Rehabilitation is a lengthy process that can take anything from several months to a year. However, sports-related motor learning and skill learning involve quicker changes, and the regions of the brain and the mechanisms involved are also different.

Although sports training involves a timeframe different from that of rehabilitation, SIGVerse can be applied to both. With the aim of creating a robot sports trainer, Associate Professor Inamura has in the past created a coaching system capable of teaching tennis through visualization of tennis swings and highlighting of good and bad movements. This system is not something that could be used by Olympic athletes or other experts, but the point is that it "allows you to view your own movements objectively."

According to Associate Professor Inamura, not only limb position information but also information on which muscles work together, how, and with what timing will be important in future applications, as will how to present this information and, in particular, sensations such as kinesthetic sense.

Because VR makes viewpoint conversion easy, it may be possible to investigate learning potentials, such as how motor learning is influenced by the presentation of a third-person overhead viewpoint or a mirror image.

How does representation in the brain change as a result of simulator-based interactions? How can this contribute to society, including the Olympics and Paralympics? Hopes are high for future developments.

(Interview/Report by Kazumichi Moriyama)

Using Informatics to Solve Problems of Urbanization and Implement True Accessibility

The Games are an opportunity to try out ICT for a "super-cyber society"

Despite being a transitory event, the Olympic and Paralympic Games—constituting the largest sports festival in the world——have evolved in such a way that they create an "Olympic legacy" that is passed on to future generations. What kind of legacy will Tokyo 2020 create and pass on to the future? NII's Professor Ichiro Satoh has two proposals: smart garbage collection and true accessibility that accommodates diverse disabilities. While Tokyo 2020 is a chance to apply academic research on informatics to practical situations, it is also an opportunity for pilot studies, and as such, trials are under way exploring how to support people with disabilities and solve problems of urbanization in the future.

Making the Olympics/ Paralympics a venue for informatics pilot studies

"Contributing directly to the Games is important, but I also want to think about the legacy that we can leave for the future," says Professor Satoh. He emphasizes the significance of holding the Games in Tokyo, the biggest city in the world. There are 25 "mega-cities" with populations in excess of 10 million people in the world today, and this number is expected to increase to 29 by 2025. This trend towards urbanization may worsen numerous problems in environmental destruction, traffic congestion, water and energy supply, crime control, and issues related to medical care and welfare.

"The Games are a major opportunity to conduct trials of methods for solving problems of urbanization precisely because they will be held in Tokyo, the city that tops the list of the world's mega-cities. We want to evaluate our methods through pilot studies and implement them in society as sustainable solutions rather than transient technologies," emphasizes Professor Satoh.

Another important area of interest for Professor Satoh is an implemention for supporting diversity, including people with disabilities at the Paralympics using ICT. Professor Satoh himself has reduced vision, and he stresses the importance of creating a framework that can accommodate diverse types and levels of disability, as well as ultimately linking support using ICT to building an environment that allows people to offer a helping hand and give appropriate support.

So what are the specifics of Professor Satoh's proposals regarding problems of urbanization and support for people with disabilities?

Ichiro Satoh
Professor, Information Systems Architecture Science Research Division, National Institute of Informatics
Professor, Department of Informatics, School of Multidisciplinary Sciences, The Graduate University for Advanced Studies

Multifunctional garbage cans and intelligent collection systems

One major problem of urbanization is garbage. Tokyo 2020 is expected to generate enormous quantities of garbage, and efficient garbage collection will be crucial in terms of both hygiene and aesthetics.

According to Professor Satoh, "Turning garbage cans into information terminals was a hot topic during the 2012 London Olympics. The idea was criticized from a privacy perspective because the garbage cans were able to acquire the unique IDs

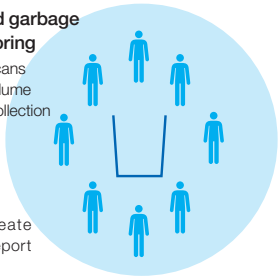
Multifunctional garbage cans

Garbage collection is not glamorous, but it finds useful application in solving problems of urbanization

The Olympics and garbage ▶▶▶ Large volumes of garbage will be generated Garbage cans will be sponsored Security concern

Proposal 1: Crowdsourced garbage volume monitoring

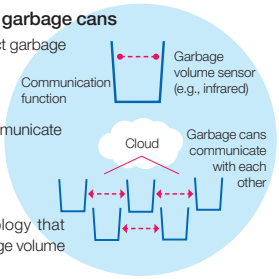
- ▶ Geared to "legacy" garbage cans
- ▶ Passersby report garbage volume
- ▶ Optimizes garbage volume collection timing



The question of how to create incentives for passersby to report garbage volume is important

Proposal 2: Smart garbage cans

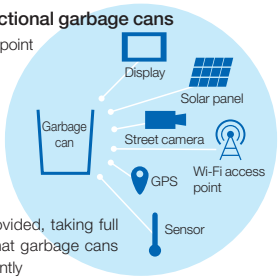
- ▶ Automatically detect garbage volume
- ▶ Request garbage collection
- ▶ Garbage cans communicate with each other



Implementing technology that simply captures garbage volume is inexpensive

Proposal 3: Multifunctional garbage cans

- ▶ Wireless LAN access point
- ▶ Security camera
- ▶ Digital signage
- ▶ Sensor node
- ▶ Other



Diverse services are provided, taking full advantage of the fact that garbage cans can be installed permanently

of wireless LAN devices carried by passersby and use them in various services. However, the technology has been improved to take account of privacy, and it is now fulfilling a new role in a public system that indicates the state of crowding on city buses. In a similar way, we want to build a garbage can system that can continue to be used as public infrastructure even after Tokyo 2020".

The "smart garbage cans" envisioned by Professor Satoh are equipped with sensors that detect the volume of garbage in each can, and by communicating with numerous other cans and a central control system, they form a system that enables garbage trucks to drive along the most cost-efficient routes and collect garbage quickly. Power-efficient short-range communication technology and wireless LAN can be applied in the system, and collection routes can be optimized using transaction processing technology and program optimization technology used in software development. Also under consideration is the idea of equipping garbage cans with security cameras, digital signage, and sensor nodes, as well as so that they can function as wireless LAN access points, in order to increase their added value.

"However, it is impossible to convert all garbage cans into smart cans. Networks centered on people (crowdsourcing) that make garbage collection be more optimized by having passersby voluntarily report the state of garbage cans are also important. A crucial aspect of this is the question of how to create incentives that encourage passersby to communicate the state of garbage cans."

Finely-tuned support that accommodates diverse disabilities

Professor Satoh's second important proposal concerns how to provide support to people with disabilities.

"On hearing the term 'disabled person', in Japan one tends to imagine someone in a wheelchair. However, there are diverse disabilities affecting vision, hearing, mental capacity, and so on, and the severities of disabilities also vary from person to person. To give one example, bumpy, yellow 'tactile paving' is used on sidewalks and station platforms, but in some cases, the color is changed to make it the same as the surroundings under the reasoning that the color surely does not matter since the people using it are blind anyway. But this design is not accessible, because people with reduced vision perceive the paving more by its color than by the bumps. Another example is curbs between sidewalks and roads, which are easily navigable to people with impaired vision, but present barriers to people in wheelchairs. There is a need for research into accessibility that is directed towards supporting this kind of diversity in type and severity of disability," says Professor Satoh.

The services that Professor Satoh has in mind are suited to the needs of the individual; for example, smartphone audio guides designed for people with impaired vision that present routes equipped with tactile paving, and guides for people with mobility impairments that use pictures to show routes without curbs or steps. Information must be acquired from users with utmost concern for privacy; that acquired information is used to determine what information should be provided. Professor Satoh has previously been involved in testing several visitor-assistant systems for museums. The systems capture location information from terminals used to guide museum visitors around exhibits and modify the guide content on the basis of visitors' current and past locations. It appears that this kind of technology could be used in providing information that is more carefully tailored to the individual needs of people with disabilities. Another potential research topic is a framework that communicates the circumstances of people with disabilities to able-bodied people who are in a location where they could provide support; such a system could enable people with disabilities to find an able-bodied person who can assist them. According to Professor Satoh, "Ultimately, it is people rather than technologies, including ICT, who provide support. ICT is a medium and support that can provide incentives that encourage people to want to assist others."

The question of how we establish not only "hard" infrastructure but also seemingly minor services in the city during Tokyo 2020 is extremely important. "I hope that people from overseas will leave with the impression that Japan is a pleasant and convenient place to live," says Professor Satoh. This field of research may seem unexciting compared to the glamor of the Games, but it is expected to flourish after the festival is over.

(Interview/Report by Masahiro Doi)

Analyzing crowd movements in realtime, and extending this technology to services

Passing the baton from London 2012 to Tokyo 2020

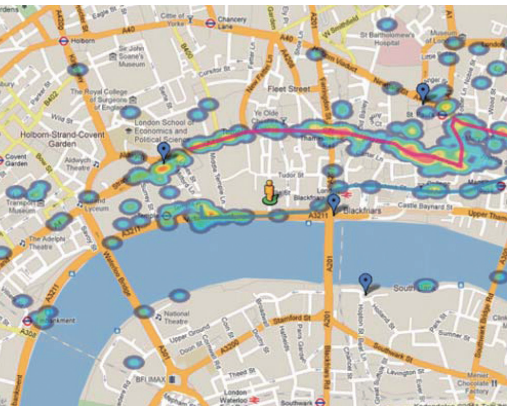
That's **Collaboration**

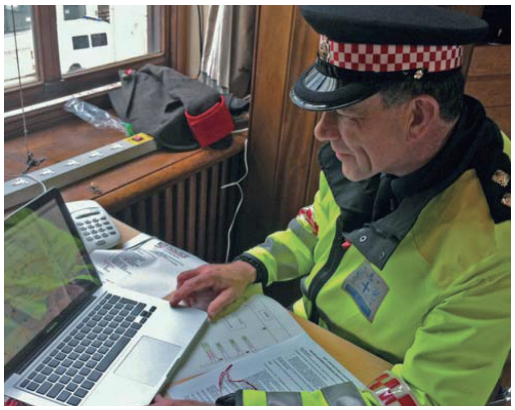
The 2012 London Olympic and Paralympic Games were dubbed the first "digital Olympics", and they led to major changes in social infrastructure and the application of ICT. Tokyo 2020 is expected to bring further digitization, so how will the baton be passed over from London 2012? We spoke to Professor Andreas Dengel, German Research Center for Artificial Intelligence, who was involved in testing realtime behavioral analysis of crowds during London 2012.

ICT application initiatives at London 2012

Befitting its label as the "digital Olympics", ICT and digital devices were used in all aspects of the 2012 London Games.
For example, in a single day during the London Olympics, the same number of tweets were made as during the entire period of the 2008 Beijing Games. Traffic on the official website reached approximately 40 billion page views just over the period of the event, and 1451 TB of information were delivered. Also, ICT infrastructure in London progressed with the installation of optical networks and the spread of free Wi-Fi and payment terminals using near-field communication (NFC). This social infrastructure is still being used in London after the Games.
The German Research Center for Artificial Intelligence (DFKI) is one of the organizations that implemented initiatives for applying ICT during the 2012 London Games.

DFKI is currently promoting a Smart City project based on three research themes: sensing & understanding, participation & creation, and interaction & use. During London 2012, they tested realtime behavioral analysis from the perspective of sensing & understanding.
DFKI's Professor Andreas Dengel worked on the project and reflects that, "During London 2012, we were still in the early stages of testing and there weren't that many participants, but we were able to display the positional distribution of registered users as a heat map. This made it possible to determine the areas where crowds were gathering and suggest appropriate transport means."
The testing in London involved building a framework in cooperation with the local police that connected to security cameras. Users were allowed to download an app to their smartphones, and based on information transmitted by this app in anonymized form, it was possible to visualize crowding as a heat map and understand the times and events at which crowds were gathering, as well as how quickly and in which directions they would try to move afterwards.
The information was also used to send messages to users' smartphones informing them which transport network they could use to avoid crowding. Thus, the system helped to reduce crowding across the city.





During the 2012 London Games, crowding was visualized as a heat map and this was used in policing.
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Extending the ICT initiatives of the Games to other events

This trial was part of the SOCIONICAL Project, and the system has been tested repeatedly since London 2012. For example, it was used at the 2012 Vienna City Marathon, the coronation of Holland's King Willem Alexander in Amsterdam in 2013, and the 2014 soccer World Cup in Brazil. Improvements are now being made to the system's provision of helpful information to the user based on the user's positional information.

"When we did a survey of users of the app, 83% reported that they liked the app. Also, 92% of respondents said that they would want to use the information provided by the app in the event of an emergency." (Professor Dengel)

The proportion of event participants who download the app is only slight more than 2%, but this provides enough data to understand crowd movements. However, it is clearly preferable to send helpful information and messages to as many people as possible.

"Efforts were made to increase the number of app users at the soccer World Cup in Brazil, and it was found that increasing the added value of the information delivered by the app and offering more features, such as visualization of information, resulted in an increase in the number of users. The system must also be developed to allow two-way communication, like a social platform."

Interestingly, it has been found that apps offered by specific companies are not very well received. Apps that can be downloaded from the event organizer's website or other official websites acquire more users. Professor Dengel emphasizes that, "building a relationship of trust between the party offering the app and the person using the app is very important."

Andreas Dengel

Professor, German Research Center for Artificial Intelligence (DFKI)

Future aims of the project include building a framework that provides information via large screens erected in popular places and allows people to obtain new information simply by holding their smartphone up to the screen, and acquiring stress information from people walking from stadiums to train stations.

Through the SOCIONICAL Project, DFKI aims to offer a platform that enables better decision making in cities.

"The SOCIONICAL Project has accomplished a technology platform that can be used at any kind of event. By adding new features and applying lessons learned, we hope that the platform will continue to evolve, like a living organism."

Expectations for Tokyo 2020

So how will the expertise accumulated by DFKI be used in the 2020 Tokyo Games? Professor Dengel starts by saying, "Given the chance, we would like to reflect the results of the SOCIONICAL Project at Tokyo 2020." He continues, "One characteristic of the 2020 Tokyo Games is that the venues are scattered over a wide area. Our platform would make it possible to measure the movements of crowds at venues and on public transport, suggest efficient transport means, and help people inside stadiums to avoid crowded concession stands. It could even allow spectators to use their smartphones to order beer and have it brought right to their seats."

He adds with anticipation, "I am sure that Japan can play a role in providing social support and giving advice and guidance to foreign tourists using advanced robots. More than anything else, it is the language that first bewilders many foreigners visiting Japan, and so the speech recognition system that NII is working on could be a great help."

Professor Dengel is a former decathlete who belonged to the German Junior National Team. "As a sports lover myself, I really hope to contribute to the success of Tokyo 2020," he says.

It is hoped that Tokyo 2020 will capitalize on the achievements of the SOCIONICAL Project.

(Interview/Report by Katsuyuki Ohkawara)

NII essay

New ICT Helping to Improve Competitive Ability

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The evolution of sensor technology and the Internet of Things (IoT) has led to the development of numerous small sensors that can be attached to the body or embedded in objects such as wristwatches, shoes, and tennis rackets, and these are widely used in health care, sports, and other areas. By linking these sensors with smartphones, it has become possible in recent years to collect realtime data on the use of sports equipment (for example, tennis racket swing speed and position of impact) and biological information from athletes (amount of exercise, body temperature, heart rate, etc.). Efforts are underway to improve the competitive ability of athletes and performance of sports equipment by accumulating these data on servers and conducting big data analysis. Also being put into practical use is technology that analyzes the movements of athletes in detail using information from video footage and sensors capable of measuring people's movements from a distance of several tens of meters with a margin of error of several centimeters (laser range scanners), and it is becoming possible to measure/analyze the activity of athletes in considerable detail.

Given this background, in our laboratory, we are working on accurately estimating in realtime the core body temperature of athletes during activity using information obtained from environmental data loggers, such as temperature, humidity, atmospheric pressure, and insolation, as well as information obtained from wristwatch-type sensors for measuring surface body temperature. Elevation in core body temperature leads to heatstroke and deterioration in athletic performance, so we hope that our research will result in early detection and prevention of heatstroke using the developed sensors. We also hope to develop technology that leads to analysis of performance and stress/fatigue level of athletes by combining technology that accurately measures and analyzes the activity of athletes and sensors that estimate fatigue level.

The evolution of sensor technology and IoT in recent years has been remarkable and could lead to a succession of new information and communication technologies (ICT) that will result in improvements in competitive abilities, correction of weak points, and reduction of stress and fatigue for Olympic athletes. At the risk of overstating things, I think that our ability to make good use of these new ICT has the potential to affect our Olympic medal count.

These technologies could also bring about major changes in the way that we watch the Olympic Games. Spectators may be able to watch through the eyes of a coach and tweet their opinions by obtaining various video information and data on athlete activity in realtime. The London Olympics were the first digital Games, and it is thought that the Tokyo Olympics will be a more advanced, new-generation digital Games (Digital Olympics Version 2.0). I hope that watching the performance of Japan's athletes will be more exciting than ever before.

Notes on cover illustration ▶▶▶ In keeping with the feature theme, we tried using robots to represent sporting events normally done by humans. We are excited to see what kind of Olympic Games will be produced by information and communication technologies in five years' time.

Weaving Information into Knowledge
NII

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