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NII Interview

Crowdsourcing Will Change Society

Exploring Structure Hidden in Real-World Data

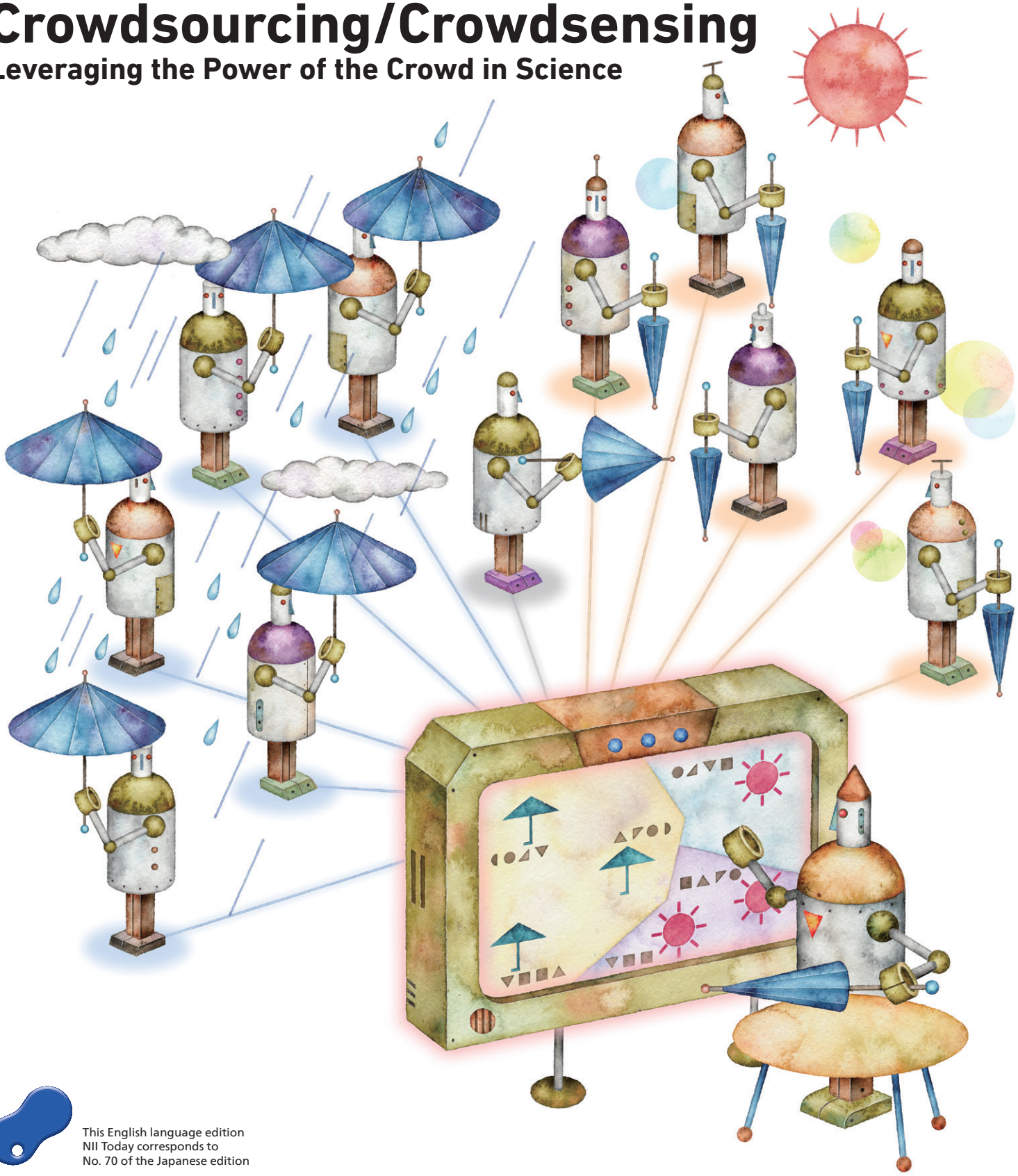
Using a Game in Quantum Computer Research

Crowdsensing Useful in Solving Social Problems

Feature

Crowdsourcing/Crowdsensing

Leveraging the Power of the Crowd in Science



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Crowdsourcing Will Change Society

What are its merits, and what challenges will accompany its popularization?

Dr. Vili Lehdonvirta (Research Fellow and DPhil Programme Director, Oxford Internet Institute, University of Oxford)
Interviewer: Keiichi Murayama (Senior Staff Writer/Editorial Writer, Nikkei Inc.)

The worldwide Internet population is approximately 3.2 billion. The environment connecting this vast number of people is changing our economy and society, including how people are employed and how they work. Crowdsourcing has become a global trend that connects businesses who want to outsource work and people who want to take on work via the Internet. What influence will crowdsourcing have on business organizations and innovation? I asked Dr. Vili Lehdonvirta, a Research Fellow at the Oxford Internet Institute in the UK.

Murayama: With crowdsourcing service providers listing shares in Japan, crowdsourcing is spreading on a global scale.

Lehdonvirta: I began researching digital labor, or crowdsourcing, in 2010. There are various types of crowdsourcing, but let's talk about crowdsourcing for business here. This ranges from outsourcing of relatively simple work to use in R&D.

Looking at a time span of several decades, the whole concept of employment in economically developed countries such as Japan, which until now was stable and permanent, is crumbling. Employment periods have shortened, and flexible, contractual employment has increased. Global competition has intensified due to internationalization, trade liberalization, and so on. Companies are exploring new forms of employment in order to remain competitive and enhance shareholder value.

Murayama: There are also technological factors behind the spread of crowdsourcing, perhaps?

Lehdonvirta: The speed and quality of the Internet has increased. In the past, I have interviewed 127 people who earn their living working online as freelancers. These were workers in developing countries such as the Philippines, Malaysia, Vietnam, South Africa, Kenya, and Nigeria. The Internet and mobile infrastructure are spread-

Vili Lehdonvirta

Research Fellow and DPhil Programme Director, Oxford Internet Institute, University of Oxford. PhD (Economic Sociology). Conducting research on the social and economic significance of new information technologies, focusing on virtual economies and online work. Visiting Scholar at the Interfaculty Initiative in Information Studies, University of Tokyo, from 2010 to 2011; Visiting Graduate Student at the Faculty of Science and Engineering, Waseda University, from 2006 to 2008.

ing in these countries too, and crowdsourcing is becoming possible.

However, there are problems associated with crowdsourcing because it easily crosses over national borders. If employment is concluded inside a country, the respective government can protect workers by way of the legal system, but this is not the case for crowdsourcing. It is not easy for a country to demand that another country apply the same labor contracts as it does, and in any case, workers may be anonymous and impossible to identify. There is also the potential for opportunism, such as fraud and cheating, to become prevalent.

Murayama: What should be done?

Lehdonvirta: At this point, one potential solution is something called a "reputation system". The US Internet auction site eBay was the first to fully introduce this system, and the idea behind it is to maintain quality by having participants evaluate each other.

However, although it appears simple and straightforward at first glance, there are difficulties. For example, people sometimes award, despite their real opinion, the highest rating of five stars even though they were not satisfied with the service they received because they fear that the other person may retaliate if they give them a low rating. This is because it is a "tit-for-tat"[Literal translation is "give-and-take"] system. The problem is how to derive genuine, rather than collusive, ratings.

Also, it is not easy to start accumulating ratings from zero and compete with people who already have many reviews and have earned a high rating. The structure is such that disparities arise between individuals. There is room for improvement in the whole system of crowdsourcing, and we need to come up with good rules.

Murayama: How will crowdsourcing change the shape of business?

Lehdonvirta: The spread of the Internet has radically changed the structure of employment costs. It has become easier to implement network-based employment as an alternative to the conventional hierarchical system of employment, and it has been suggested that companies will become smaller as a result.

However, there are various reasons for the existence of business organizations. In particular, there are some effects that cannot occur without the business organization, for example experiencing an identity and sharing a vision, which can increase motivation. Therefore, I do not think that we will reach a point where all employees work as freelancers.

Murayama: R&D is a more important operation as far as business is concerned. Do you think the time will come when crowdsourcing is commonplace in R&D?

Lehdonvirta: The main benefit of using crowdsourcing in R&D is the effect of open innovation. Conventionally, a company's ability has been restricted to the abilities of the staff employed in the company, but using the Internet, it becomes possible, in principle, to access all abilities. Various ways of thinking can be obtained from a diverse group of people, compared to a homogeneous group.

One point that requires attention, however, is whether companies are capable of absorbing and making effective use of technology and ideas taken in from outside. Ideas for boosting productivity by 10%, for example, may be realized by modifying existing equipment or procedures, but more fundamental ideas could require changing the entire business model.

This is not simply a matter of it being okay to change everything using open innovation. In addition to winning future customers through innovation that reforms their business model, companies have to serve their existing customers. It is important to strike a balance between current and future customers.

Murayama: In Japan too, values have diversified and various ways of working are now accepted. Do you think that the addition of crowdsourcing as an option should be viewed positively?

Lehdonvirta: It would seem preferable to have more options, but of course, there are complex problems involved. When a company is referred to as bureaucratic, it creates a negative impression, but in a sense, this kind of company could also be described as fair because it is capable of reducing discrimination by applying rules to ensure that employees are promoted when they acquire the necessary abilities and skills, regardless of gender or race. Whereas, if this is left to the free market, as in crowdsourcing, there is a risk that discrimination will occur. In fact, looking at the US car dispatch app Uber Technologies, it appears that black drivers are more likely to get low ratings. In a taxi company, such discrimination could be controlled by way of company rules. The risks of relying on market forces should not be overlooked. Much more research is needed.

(Photography: Yuki Akiyama)

A Word from the Interviewer

With the ability to serve the diverse needs of individuals in relation to ways of working and the potential to become a driving force for corporate innovation, there is no doubt that crowdsourcing holds great promise. However, as Dr. Lehdonvirta: repeatedly emphasizes, it also conceals new problems and challenges. While closely monitoring the situation, we must acquire the knowledge to master crowdsourcing.

Keiichi Murayama

Joined Nikkei Inc. in 1992. Covered telecommunications, electronics, automotive, finance, etc., in the Business News Department. After working in the Silicon Valley Bureau and the Electronics News Department, became a senior staff writer in April 2012. Has worked concurrently as an editorial writer since April 2015. Currently, his main areas of responsibility are IT and startups.

Exploring Structure Hidden in Real-World Data

Aiming to promote value creation and citizen science

Asanobu Kitamoto
(Associate Professor, Digital Content and Media Sciences Research Division, National Institute of Informatics/
Associate Professor, School of Multidisciplinary Sciences, The Graduate University for Advanced Studies)

Weather disaster prevention, participatory monitoring of invasive species, cultural heritage archives, memories of the Great East Japan Earthquake... making use of not only conventional observation data collected by specialists but also data collected by the general public will reveal the structure of a previously unseen world. NII Today spoke to Associate Professor Asanobu Kitamoto, who is trying to open up a new world by tackling diverse subjects using image processing, technologies for utilizing big data, and citizen science.

Raising awareness and gaining learning opportunities

Associate Professor Kitamoto has worked on a wide range of different projects. These have included "Digital Typhoon", an integrated database of typhoons including images from weather satellites to measure typhoons, typhoon tracking data, and textual information from social media about typhoons; "Typhoon Front", a user-generated typhoon information site; and "Senga—Silk Road", an interactive digital archive that enables users to create and display virtual exhibitions using images of Silk Road cultural heritage to be printed as an original picture postcard.

The common theme in all of these projects is "generating value using real-world data". Real-world data are data that link to reality, including unstructured data from the public. Associate Professor Kitamoto is attempting to generate valuable information and present it as media that takes advantage of new technology. For example, in the GeoNLP Project, he is conducting research on automatic extraction of place names from text and linking place names to locations. Allocating[Consider "Extracting".] location information is an important step in making people take action, particularly during disasters. Rather than simply showing information to people, Associate Professor Kitamoto aims to create media that convey messages or stories that translate into action.

One might suspect the value of data obtained from the general public. These data are, of course, pointless if they are just a poor man's version of existing sensors. For example, precipitation amounts can be found using existing sensors. However, existing sensors cannot give an answer to whether precipitation is rain or snow. This information is currently estimated from air temperature at the ground surface. However, if it were possible to gather comments, such as "It's started snowing" or "It's sleeting", from the public via social media, and to map these comments in chronological order, we would obtain information that has never existed before.

Tools for public participation are being developed. "Memory Hunting" is a smartphone camera app that enables users to take a photograph at the same location and same angle as a previously taken photograph. It was originally developed as part of the Digital Silk Road Project for finding locations where old photographs had been taken. The use of an app that allows multiple photographs to be taken with the same composition makes it easy to carry out fixed-point observations. It enables information to be acquired more widely and from any area, in addition to fixed-point observations from satellites and ground-based observations from existing sensors.

However, Associate Professor Kitamoto explains that citizen science is not simply a device for collecting data. In crowdsourcing, the mission is to complete a task, but in citizen science, the citizens who participate are not workers but collaborators. For them, citizen science is a learning opportunity that raises their awareness of their surroundings and brings the world into sharper focus. Also, there is value in it if citizens become able to consider the whole picture.

Figure1 "**Seiyou Status**", **a citizen-based monitoring project to control an invasive species.**
Ongoing activities are being carried out in cooperation with the Laboratory of Conservation Ecology at the University of Tokyo (currently, the Hokkaido Biodiversity Conservation Activities Cooperated Support Center) to control Bombus terrestris, which is designated as an invasive alien species. Reports of sighting and capture are published on a website in list and map formats.

Sharing of goals is important

The "Seiyou Status" project to control an invasive species in Hokkaido is a typical cit-

izen science project. Focusing on citizen-based monitoring, the project publicizes information on the capture and sighting of an invasive species of bumblebee, Bombus terrestris. The project runs short courses locally to teach people how to capture the bees and what to do if they get stung, and gathers capture results to show the invasion status on a map. Ecology researchers can use this information to examine how the bee spreads and how land should be used, and citizens become more aware of the problem of invasive species.

The important thing is not just whether there are people who can get citizens involved but also whether the goal of the project is shared. "People will not participate unless there is a shareable goal." In the case of "Seiyou Status", the goal is to protect the ecosystem.

There is also a project planned in Hokkaido this winter to observe snow conditions based on citizen participation making use of the "Memory Hunting" system for taking photographs with the same composition.

However, when the goal is disaster prevention, despite being a goal that is easily shared, it is difficult to sustain motivation among participating citizens. It is fun to observe phenomena that cause big changes in a short time, such as observing the flowering of the cherry blossoms as a seasonal change, but when it comes to disaster prevention, most of the time the situation is normal and nothing happens. This makes it easy to forget the goal of disaster preparation.

In this context, Associate Professor Kitamoto is focusing on "emotion sensing" as a way to observe citizens using their comments. Emotions are not objective: they can only be obtained through people. For example, information such as the water level of a river can be obtained using existing sensors, but information about how residents feel about the subjective risk of the water level of the river can only be obtained via people.

Proposing new methods of research

Research handling real-world data has its own particular difficulties. For example, the fields of meteorology and informatics have different ways of approaching research questions and solutions. Associate Professor Kitamoto deals with past data using informatics techniques and carries out research from the perspective of how to use these data in today's decision making. Meteorologists, on the other hand, rarely do this kind of research because they are interested in the actual weather phenomena themselves.

However, collaboration is necessary. There are limits to the meaning that informatics researchers alone can draw from data.

"We lose the potential of research if we regard it as research confined to informatics, but if we do it together with meteorologists, we must find common themes."

Carrying out research across disciplines is not easy, because both sides have to take a completely new approach to their research. However, unless disciplines are crossed, truly interesting discoveries will never be made.

Figure 2 "**Memory Hunting**", **a smartphone app that enables users to take a photograph at the same location and same angle as a previously taken photograph.**

Associate Professor Kitamoto says that what informatics can do in such circumstances is "propose new methods of research."

Open science and citizen science are initiatives for exploring new possibilities together, while promoting mutual understanding.

(Interview/Report: Kazumichi Moriyama,
Photography: Kazuyoshi Oyama)

Asanobu Kitamoto

Quantum Computer Game

Computer game can assist the research to realize quantum computers

Kae Nemoto
(Professor, Principles of Informatics Research Division,
and Director of the Global Research Centre for Quantum Information Science, National Institute of Informatics/
Professor, School of Multidisciplinary Sciences, The Graduate University for Advanced Studies)

Professor Kae Nemoto and her research team have developed a computer game called "meQuanics" that allows the general public to help optimise real-world quantum computational circuits and reduce the number of devices in a future quantum computer. They have released a prototype client that can be played and tested online. When a player starts the game, a puzzle consisting of colorful, tangled shapes appear. By twisting and shaping the puzzle, players make them smaller and optimise resources for an actual quantum computer. The team aims to attract a large user base of active players using smartphones and tablets and uses the power of crowd-sourcing to advance their research into large-scale quantum computers.

Promoting research with a puzzle game

There are two aspects to the game developed by Professor Kae Nemoto and her team, meQuanics: the quantum computer game. One is the actual game itself, which is directly related to how a quantum computer will be built and programmed. The other is to allow the game to use "crowd-sourcing" to help make circuits smaller, faster and easier to implement. Crowd-sourcing is the process of using the resources of individual people to help solve complicated problems. meQuanics is based around a model of quantum computing[1] known as topological computation, which is currently the most promising architectural framework for building quantum computers, a reality and a primary research topic in the research center led by Professor Nemoto.

"The primary aim with meQuanics is to build a game that lots of people can enjoy playing and by playing, you are actively advancing research by helping compile and optimise quantum algorithms," says Professor Nemoto.

"Reducing the size of circuits makes it possible to reduce the size of quantum computers, shorten processing times and ultimately making the machine easier to build. By making the circuits in meQuanics smaller, you can have the same effect as asking experimentalists and engineers to make devices ten times more accurate. Since the problem in meQuanics doesn't require any fancy equipment or expensive manufacturing, this could be of enormous benefit."

The interesting thing about meQuanics is how accurately we can reflect the physics and engineering within a gaming environment. "The puzzles actually represent the circuits themselves, we don't have to approximate the physics or the information theory itself. Hence the compilation and optimisation itself links naturally to solving a 3D puzzle game. We were lucky in that the problem itself contained puzzle-like elements," reflects Professor Nemoto.

A characteristic of the topological quantum computers that Professor Nemoto is researching is that crucial error correction protocols, needed to compensate for inaccuracies in the quantum hardware, is built into the formalism. We encode one quantum bit (qubit) of information using hundreds, maybe thousands, of physical qubits. It is this redundancy that protects the information in the computer. Algorithms are executed by manipulating a large 3D array of qubits in a topological way, and this representation of an error corrected algorithm can be represented as a 3D puzzle. These puzzles are what is used by meQuanics.

When quantum circuits are translated into these 3D puzzles, they are unnecessar-

Figure Screenshot of the meQuanics game
Players reduce the size of the entire puzzle by moving, cutting, and connecting puzzle pieces in 3D.

References

[1] quantum computing
Quantum computers have the potential to dramatically outperform the "classical computers" in a wide variety of important problems. Experimental construction and demonstrations of quantum computers is happening throughout the world, and essentially every large-scale hardware model is now based on the topological model of computation. In these models, error-corrected quantum bits (logical qubits) are defined by quantum correlation (entanglement) of numerous physical quantum bits. Logical qubits carry information, and calculations progress by interacting and entangling these encoded qubits. This process looks like a three-dimensional puzzle, and the same calculation can be done as long as the topological properties are not changed, which means that it is possible to reduce the volume of the entire graphic by modifying it according to certain rules.

ily large. There is a lot of wasted space and therefore wasted hardware resources. Initially, Professor Nemoto and her team used manual techniques to try and optimise these circuits. By using programs such as Google SketchUp, her team spent days painstakingly compressing and shrinking topological quantum circuits. This approach was very error prone as small mistakes with manually optimising circuits destroyed their functionality. The meQuanics game essentially evolved out of the need to develop software that would automatically enforce the quantum mechanical rules. If the software made sure that no mistakes were made, then you could optimise freely without constantly checking that trivial mistakes were not appearing. As Prof. Nemoto and her team slowly developed this software, it became clear that it could be turned into a popular game. Both science minded people and casual gamers could then participate and help solve the problem. "I was a complete novice at developing computer games, but when I tried creating a tool that simply allowed users to modify a circuit according to the rules, I was surprised to find that it started to look like a computer game.", recalls Prof. Nemoto.

A multinational team

Nevertheless, it took many collaborators and extraordinary effort to reach the point of releasing the tool as a game.

The game development project began in January 2013. The development work was done by a multinational team, with no two people from the same country. In addition to Professor Nemoto, the team consisted of specially-appointed Assistant Professor Simon Devitt, who is Australian, a French designer, a German game programmer/designer, and a British back-end developer. Professor Nemoto describes the intense discussions by this team of diverse and strong individual skills and characters as "explosive". "We would have explosive but exciting discussions at a frequency of about once every week or two" (Professor Nemoto). This was primarily due to the clashes of wills of talented people who were coming from completely different standpoints—some wanting to make the tool interesting as a game and some wanting to contribute to research.

"The game developers wanted to make the tool appealing as a game, while we wanted to maintain as much scientific accuracy as possible. This led to some heated discussions."

Looking back on the game's development, Professor Nemoto says, "A sense of speed was necessary, and unless the people developing the game felt it fascinating, there wouldn't be any success." The concentration and excitement of the development process were key to making the game fun.

During the development of meQuanics, a married couple who were working as visiting researchers brought along their two children, who became absorbed in the game and fought with each other to play it. Seeing that, "I felt confident that it could be exciting enough," laughs Professor Nemoto.

Gathering a wider range of wisdom

The alpha version of meQuanics was released in May 2013. A number of issues that needed to be resolved became apparent during the development and release of the prototype. Some aspects of the game's interface are still difficult to understand. For example, a tutorial or set of instructions about how a puzzle is manipulated is needed. Also, it was found that players require an intuitive game interface that allows you to sit down and start playing without having to think too much. Making the goal of the game interesting and easy to understand is also a key component in making the platform successful.

Professor Nemoto is planning to widen the range of players by resolving these issues, while also targeting mobile environments. Research activities and game development require different ways of thinking, different timescales, and different ways of using funds, and Professor Nemoto is therefore also considering financing through crowdfunding.

If a wider range of people start playing the game and obtaining high scores, we will get closer to realizing a topological quantum computer. This is the starting point in the first crowd-source attempt to solve an important problem not only in quantum information, but in physics itself.

(Interview/Report: Akio Hoshi,
Photography: Yusuke Sato)

Kae Nemoto

Crowdsensing Useful in Solving Social Problems

Using environmental sound maps in tourism and disaster prevention policy making

Masanobu Abe
(Professor and Vice-Dean, Faculty of Engineering, Okayama University)

Noboru Sonehara
(Professor and Director, Information and Society Research Division, National Institute of Informatics/Professor, School of Multidisciplinary Sciences, The Graduate University for Advanced Studies)

Professor Masanobu Abe, Okayama University, and NII's Professor Noboru Sonehara are currently working together to build an environmental sound collection system using crowdsourcing and crowdsensing. In crowdsensing, smartphones and vehicle-mounted devices used by participants serve as sensors and collect data. This joint project aims to recruit members of the public to collect environmental sounds from the streets using their smartphones, and to make use of this data in policies for attracting tourists and solving social problems, including for disaster prevention and crime prevention.

Using the power of the public in policy making

—What made you start developing an environmental sound collection system using crowdsensing?

Abe: Suppose, for example, that an advertisement for a residential building describes a neighborhood as a "quiet residential area". There is nothing to show quantitatively just how quiet the area is. People often find, when they actually live in an area, that it can be noisy depending on the time of day. Or, you might stay at a hotel where the walls are so thin that you can hear the sound of the shower and people talking in the neighboring room. You can check the visual information of a place to some extent using Google Street View, for example, but sound information is surprisingly scarce. That was our starting point.

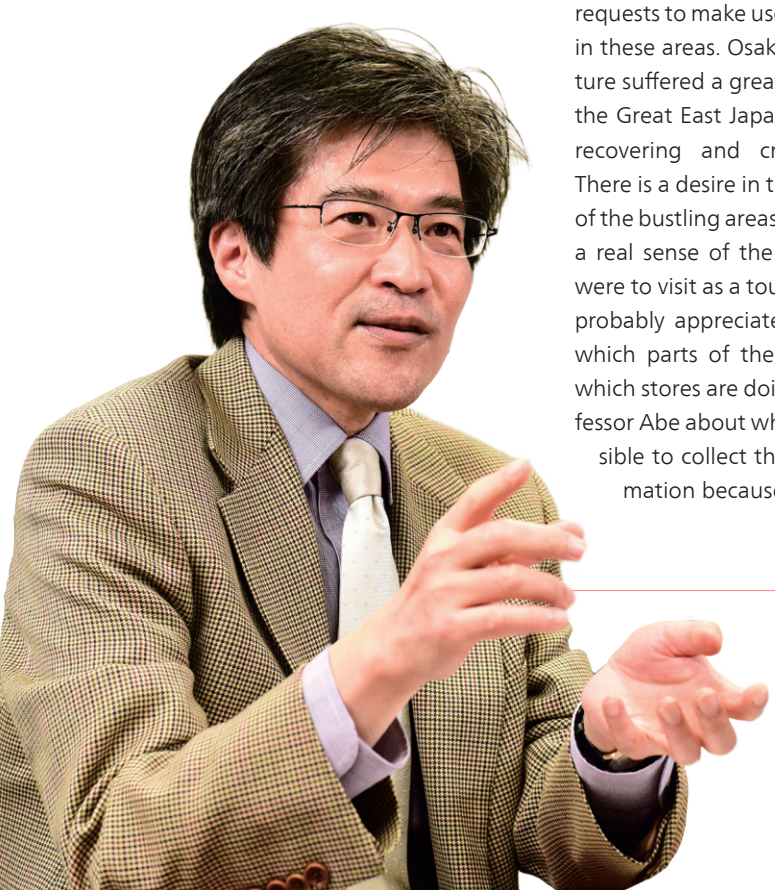
Sonehara: Nowadays, I am often involved in policy making on regional tourism, disaster prevention, and so on, and there are requests to make use of sound information in these areas. Osaki City in Miyagi Prefecture suffered a great deal of damage from the Great East Japan Earthquake, but it is recovering and crowds are returning. There is a desire in the city to create a map of the bustling areas so that people can get a real sense of the city's liveliness. If you were to visit as a tourist as well, you would probably appreciate knowing in advance which parts of the city are buzzing and which stores are doing well. I spoke to Professor Abe about whether it would be possible to collect this kind of sound information because I knew that he was a researcher in speech processing and had worked in fields such as lifelogs and regional monitoring systems.

—And the collection of this environmental sound is done using smartphones.

Abe: By using smartphones and having large numbers of people participate, we are able to collect information uniformly, both temporally and spatially, rather than just having a monthly fixed-point observation, for example. The "resolution" is completely different from that of conventional measuring methods.

Sonehara: Also, crowdsourcing is a method that is familiar in tourism development. For example, there is a sightseeing spot in Japan that, for some reason, is only visited by Thai people. It appears to have become popular as a result of Thai visitors to Japan posting on social networking sites such as Twitter. Crowdsourcing is effective in this way for discovering sightseeing spots. If we could collect a variety of information such as "beautiful", "peaceful", "dirty", in a similar way to the "Like" button on Facebook, we would be able to easily create sightseeing maps that reflect the mental images of the people who have visited.

Similarly, this kind of public power can be used in policy making. For example, if crowdsourcing could be used to take up comments from city inhabitants, such as "The streets are dirty" or "The railing on the bridge is damaged," it could be useful in prioritizing administrative services. Moreover, responses could be based on scientif-



Masanobu Abe

Received master's degree from Waseda University in 1984. Joined Nippon Telegraph and Telephone Public Corporation in same year. Served as Project Manager at NTT Cyber Solutions Laboratories before becoming a professor in the Graduate School of Natural Science and Technology, Okayama University in 2010. PhD (Engineering).

ically grounded data, rather than instinct and experience as they are now. This kind of policy making based on citizen participation using IT and other technologies is known as "civic tech", and nowadays as local government finances are tight, civic tech is showing promise as a trump card for cutting public finances. If environmental sound could be added as part of this information and displayed quantitatively, it would have the potential to be useful in various contexts, including for noise control measures, town revitalization, monitoring, safety and security, and disaster prevention.

Passive and active participation

—Specifically, how will the information be collected?

Abe: There are two types of environmental sound collection. One type senses the power of sound (decibels). The app we have developed works in the background when participants are using smartphone apps such as Twitter and Line, and it automatically measures and uploads the power of ambient sound together with the time and place. In doing so, for the sake of privacy, the app does not collect information such as the content of conversations or what the sounds are. The other type of collection acquires the actual sound. We are trying to build an environmental sound database by having participants upload sounds that leave an impression on them, such as the babbling of a stream or the shrilling of a cicada. The app provides for both passive and active participation.

For sounds collected through active participation, the app has buttons that allow the participant to subjectively evaluate noise level and crowdedness level on a scale of 1 to 5. This enables us to find that the same level of sound is perceived differently depending on the time of day and location. Sound has a considerable influence on people's minds and bodies. People may feel unwell while exposed to noise, even if they do not think that the sound is unpleasant. If we create a noise map that includes subjective evaluations, it may be of use in health care.

We have already started collecting data on a trial basis in the center of Okayama City using a prototype app, and even looking at the collection results of just four or five people, it is clear that there are large differences in the power of environmental sound depending on location between noon and six in the evening. You can see at a glance that the downtown area gets busy in the evening.

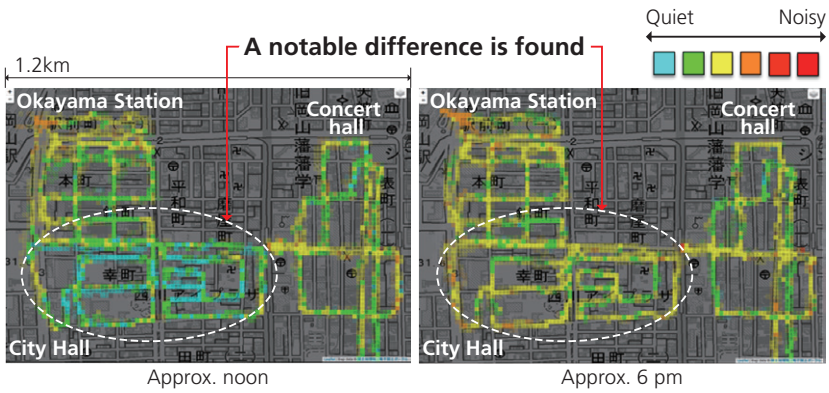


Figure Visualization of noise levels

Noise levels measured in Okayama at around noon and 6 pm, November 2014. Colors indicate observation points, that is, places where there were people carrying smartphones containing the developed app. At both times shown, the area around the station is orange, meaning somewhat noisy. However, the area inside the ellipse is noisier at 6 pm. The map makes it very clear which areas of the city are noisy. Also, by using the environmental sounds to estimate the types of sources that are causing the noisiness, it is possible to extract higher-order information such as places where there are a lot of people and places where there are a lot of cars.

The benefits of data protection and utilization

—Guaranteeing the reliability of data is an issue in crowdsourcing.

Abe: I think that this is exactly where crowdsensing is useful. Rather than just recording data, superimposing physical sounds and location information proves that the participant really was at that location and can improve the reliability of the information.

Sonehara: Obviously, it is essential that privacy be considered. The challenge is how to increase the value of data while preserving privacy. If benefits such as being useful in regional development or disaster prevention become clear, the public's cooperation can probably be won. Participation can also be encouraged through incentives such as discounts or points.

Abe: When big data is mentioned, the focus tends to be on the volume of data, but in fact, the source of big data's value is in the diversity of the information. Unexpected value can be created by superimposing various data. I think that crowdsourcing and crowdsensing are extremely useful techniques in the sense that they compensate for things that computers cannot do using people power and make it possible to collect diverse information.

Sonehara: Some say that this kind of research is not academic, but our efforts are in presenting a platform for solving social problems using raw data. Going forward, our main role will increasingly be to respond to the needs of society, and the power of the public will be a key element in this.

(Interview/Report: Madoka Tainaka,
Photography: Kazuyoshi Oyama)

Noboru Sonehara

News 1 Five SINET presentations across Japan

—Increasing interest in 100 Gbps SINET5

NII holds annual presentations on the Science Information NETwork (SINET), Academic Access Management Federation (GakuNin), and UPKI Digital Certificate Services, in order that this advanced academic information infrastructure—being built and operated by NII—is used and promoted more effectively. This year, NII hosted five presentations across Japan starting in Fukuoka on November 4, followed by Kyoto (Nov 5), Sapporo (Nov 20), Nagoya (Nov 30), and Tokyo (Dec 7). The events included discussions with users and individual consultations.

SINET is an information communication network built and operated by NII as academic information infrastructure for universities and research institutions throughout Japan. The network has nodes (network connection points) nationwide, and it provides universities and research institutions with an advanced network for supporting the formation of communities among the large numbers of people involved in education/research and encouraging the circulation of a wide range of academic information. In April of next year, the network will migrate to SINET5, which will realize an ultrahigh-speed network connecting the whole of Japan at 100 Gbps.

The presentations at each venue focused on providing an overview of SINET5, which will start operation in fiscal 2016, and explaining the work of migration to SINET5, as well as explaining other infrastructure including the UPKI Digital Certificate Services, GakuNin, eduroam (International Academic Wireless Roaming Network), and GakuNin Cloud. At the Kyoto and Tokyo venues, the presentations included an update on the state of development of academic content services for SINET5.

There were large numbers of attentive participants at each venue, with around 80 people in Fukuoka and 200 in Kyoto (photograph). The individual consultations answered questions about SINET5 migration, switching to the shared repository service JAIRO Cloud, and other topics.

News 2 Exhibition at 17th Library Fair & Forum

—Around 880 visitors, and Forum presentation

The 17th Library Fair & Forum was held at Pacifico Yokohama on November 10–12, and NII exhibited a booth introducing the latest developments in NII's services for libraries and library users.

In a presentation titled "An A to Z of NII Services—NII's Developing and Deepening Services" in the forum on the first day, members of staff in NII's Scholarly and Academic Information Division, who are responsible for actually operating these services, presented an overview of the services and how to use them (photograph). The forum was also broadcast via Ustream.

NII's booth introduced services such as CiNii Dissertations, ERDB-JP, JAIRO Cloud, KAKEN & JST project databases, and NII-REO. Around 880 people visited the booth, and there was much interest in CiNii Dissertations, a one-stop service for retrieving doctoral dissertations in Japan that only became fully available to the public in October.

News 3 Conveying the appeal of research using demos

—Inter-University Research Institute Corporation Symposium 2015

NII exhibited at the Inter-University Research Institute Corporation Symposium 2015 held at Akihabara UDX on November 29.

NII's booth presented two demonstrations designed to show the appeal of NII's research to the general public and particularly to young people who will take on future research. In a demo of PrivacyVisor, privacy-protecting glasses developed in the laboratory of Professor Isao Echizen (Digital Content and Media Sciences Research Division), visitors who tried on the glasses were able to experience how they prevent camera face detection. The laboratory of Associate Professor Michihiro Koibuchi (Information Systems Architecture Science Research Division) displayed a "submerged computer" with a completely waterproof motherboard that was immersed in a tank of water. The researchers are attempting to reduce power consumption by cooling computers using natural energy, and visitors asked Associate Professor Ikki Fujiwara (same division), who was explaining the technology, about its potential applications.

The Symposium also featured "Researcher Talks", where researchers spoke about latest topics and the appeal of their research. From NII, Associate Professor Koibuchi gave a lecture titled "Architecture of Future Computers: Using Water and Light".

Flash

▶ Hosting the 2nd SPARC Japan Seminar 2015

NII hosted the 2nd SPARC Japan Seminar 2015 (Open Access Summit 2015) on October 21 to coincide with International Open Access Week. The keynote address was given by Secretary General of the Research Data Alliance (RDA), Mark Parsons.

In seminars titled "Science and Research Data" and "Research Data Infrastructure of Japan", NII's Associate Professor Asanobu Kitamoto (Digital Content and Media Sciences Research Division) and Professor Keizo Oyama (Digital Content and Media Sciences Research Division), as well as other researchers involved in academic information from across Japan, explained the current status of research data use and sharing.

In panel sessions, researchers and librarians discussed the research support environments in demand today.

Topics

Artificial Intelligence Project "Can a Robot Get into the University of Tokyo?"

Deviation score of 57.8 in the practice test for National Center Test for University Admissions

The artificial intelligence (AI) project "Can a Robot Get into the University of Tokyo?" (Todai Robot Project) presented this fiscal year's results on November 14 in Fukutake Hall, Interfaculty Initiative in Information Studies at Hongo Campus, the University of Tokyo.

The Todai Robot Project began in fiscal 2011. University entrance exams are integrated tasks, the results of which can be evaluated quantitatively using points and deviation scores, and the aim of tackling these exams is to present an objective benchmark for AI evolution that can act as a guide when considering questions such as "In which fields could AI replace humans?" The goals of the project are to achieve a high score in the National Center Test for University Admissions by 2016 and to pass the entrance examination for the University of Tokyo by 2021.

The Todai Robot Project is a joint research project in which university and corporate laboratories and research departments take the exam in subjects consistent with their respective research goals. The scores of the organization or team with the best result in each subject are taken as the grades achieved by "Torobo-kun", the name of the AI being researched/developed in this project.

This fiscal year, Torobo-kun took the June 2015 practice version of the Center Test run by Benesse Corporation. The AI achieved good results with a total score of 511 (national average, 416.4) and a deviation score of 57.8 in 8 subjects across 5 fields of study. These results give Torobo-kun a chance of at least 80% of being accepted by 1,055 departments in 441 private universities and 39 departments in 33 public universities. By subject, Torobo-kun recorded deviation scores above 60 in three subjects: Math I A (deviation score 64.0), Math II B (65.8), and World History B (66.5).

Also, with the cooperation of Surugadai Gakuen's Sundai Preparatory School, Torobo-kun took the 1st (2015/2016) Practice Exams in August for entry into the University of Tokyo aimed at essay-type individual achievement tests (second-stage exams) in geography and history (world history) and math (in humanities and science). The AI achieved a deviation score of 54.1 in its first attempt at the world history test.

ロボットは東大に入れるか２０１５　結果概況
進研模試 総合学力マーク模試・6月

ベネッセコーポレーション 2015年度進研模試 総合学力マーク模試・6月
（受験者総数 44.0万人）

	国語	数学		英語		理科	地歴		5教科8科目総計
		数学IA (*1)	数学IIB (*1)	英語（筆記）	英語（リスニング）	物理 (*2)	日本史B	世界史B	
配点	200	100	100	200	50	100	100	100	950
東ロボ得点	90	75	77	80	16	42	55	76	511
学生平均点	105.4	45.5	42.8	86.0	24.6	49.4	46.6	45.9	416.4
東ロボ偏差値	45.1	64.0	65.8	48.4	40.5	46.5	54.8	66.5	57.8 *3

*1 数学については、問題文を機械が理解可能な形式表現に変換する過程で、現在開発中および今後開発予定の部分（数式の意味解釈、文間の関係の解析など）に限り、一部、人手による追加・修正を加えた。

*2 物理では、人手で問題文を機械処理可能な形式表現へと変換した。

*3 5教科8科目文系型(国, 数2科目, 英筆記及びリスニング, 地歴2科目, 理1科目)での受験者11.6万人で集計した偏差値

ロボットは東大に入れるか２０１５　結果概況
第１回東大入試実戦模試

駿台予備学校 2015/2016 第1回東大入試実戦模試《数学》
(受験者数 12,334人: 文系4,130人 理系8,204人　うち 数学受験者: 文系4,101人 理系8,162人)

【文系】*1	問1	問2	問3	問4	総計
配点	20	20	20	20	80
学生平均点 *2	5.3	8.6	2.0	9.2	25.0
東ロボ得点(結果点のみ) *3	4	-	5	3	12
東ロボ偏差値(結果点のみ) *3	47.5	-	57.7	40.6	41.4
東ロボ得点（満点とした場合）*4	20	-	13	6	39
東ロボ偏差値（満点とした場合）*4	78.3	-	78.2	45.2	59.2

【理系】*1	問1	問2	問3	問4	問5	問6	総計
配点	20	20	20	20	20	20	120
学生平均点 *2	10.7	4.1	3.9	2.9	4.2	5.3	31.1
東ロボ得点(結果点のみ) *3	-	-	2	-	0	-	2
東ロボ偏差値(結果点のみ) *3	-	-	47.1	-	37.6	-	35.1
東ロボ得点（満点とした場合）*4	-	-	20	-	0	-	20
東ロボ偏差値（満点とした場合）*4	-	-	74.8	-	37.6	-	44.3

駿台予備学校 2015/2016 第1回東大入試実戦模試《世界史》
(受験者数 12,334人: 文系4,130人 理系8,204人　うち 世界史受験者 3,488人)

	問1 600字以内の論述1題 西欧とアジアの国家体制の変遷	問2 60-90字以内の論述5題 都市間のヒトやモノの交流	問3 単語回答式10題 世界史上の文字と言語	総計
配点	26	24	10	60
東ロボ得点	9	4	8	21
学生平均点*2	4.3	6.5	6.4	17.2
東ロボ偏差値	61.8	44.4	57.0	54.1

*1 数学については、問題文を機械が理解可能な形式表現に変換する過程で、現在開発中および今後開発予定の部分（数式の意味解釈、文間の関係の解析など）に限り、一部、人手による追加・修正を加えた。

*2 現役、既卒あわせての平均点

*3 途中過程に対する加点を行わず、解答結果の正否のみについての加点を行った場合の得点と偏差値

*4 途中過程での得点を満点とした場合の合計得点と偏差値

(注) 表中の "－" は無回答であったことを示す。

SNS

"Hey, this is great!"

Hottest articles on Facebook and Twitter (August–November 2015)

National Institute of Informatics, NII (official) Facebook
www.facebook.com/jouhouken/

Towards commercialization of PrivacyVisor for preventing face detection

Helping to develop local industry by implementing research findings in society

Hyakuo Makino, the Mayor of the Sabae City in Fukui Prefecture—a city famed for making eyewear—announced today (August 6) that companies in the city would be commercializing PrivacyVisor. PrivacyVisor is the name for the glasses developed by Professor Isao Echizen and his team in NII's Digital Content and Media Sciences Research Division that protect the privacy of the wearer by making it impossible for cameras and other devices to recognize their face. (August 06, 2015)

National Institute of Informatics, NII (official) Twitter
@jouhouken

Assistant Professor Takuya Akiba has advanced into the finals of the Google Code Jam, a global programming contest being held in Seattle. (August 11, 2015)

Bit on Twitter! Twitter
@NII_Bit

Assistant Professor Akiba, leader of Team Unagi, is looking very pleased the day after his team was announced the winner of the ICFP Programming Contest 2015! Congratulations! (September 02, 2015)

*Some text omitted.

Essay

Can Crowdsourcing Solve the Problem of Unemployment?

Takayuki Mizuno
Associate Professor, Information and Society Research Division, National Institute of Informatics

Let's look at the potential of crowdsourcing from the perspective of the problem of unemployment. It is important for the nation that unemployed people find work. Considering crowdsourcing websites as labor markets where employers seeking workers and people seeking jobs are matched together, is it possible to solve the problem of unemployment by analyzing the activity logs of these employers and people seeking jobs?

In economics, the following reasons are given for there being unemployed people in Japan who would like to work: ❶ there are job vacancies, but the unemployed person is incapable of searching for them (in job magazines, etc.); ❷the employer with job vacancies to fill cannot find the unemployed people; ❸there are no job vacancies (in the unemployed person's area of residence); ❹ there are job vacancies, but the unemployed person does not have the required skills; and ❺ there are job vacancies, but the pay is low and so the unemployed person chooses to be unemployed while looking for another job. It is anticipated that Reasons ❶, ❷, and ❸ could be addressed by crowdsourcing that makes all information about employers seeking workers and people seeking jobs easily searchable, and also makes it possible for people to work without being dependent on a particular area. With regard to Reason ❹, small-to-medium-sized companies find it difficult to recruit workers despite not requiring high-level skills, and so it may be the case that the unemployed person is looking only for jobs in large companies without realizing that jobs matching their skills are only available in small-to-medium-sized companies. Reason ❺ may be because employers seeking workers do not realize that the pay they are offering is lower than the market rate. In any case, the economics perspective is that with crowdsourcing sites where everyone can obtain large amounts of information, there will be fewer unemployed people.

Then is it really sufficient to simply provide both employers seeking workers and people seeking jobs with lots of information? In some cases, there may be information that is obscure or hinders matching, and so not only will the number of unemployed not decrease but it may actually increase. For example, let's consider a site that provides a rating history of employees by employers and a rating history of employers by employees. Job seekers will flood highly rated employers with applications, and employers seeking workers will compete over highly rated job seekers. Jobs (or people) will become concentrated on the highly rated job seekers (or employers), and their ratings will successively rise. Meanwhile, those who do not get a good rating at the outset will not receive any jobs (or people) at all, and so they will not be able to improve their rating. In the end, without matching progressing smoothly, there will still be many unemployed people and companies with staff shortages.

Unlike offline labor markets, crowdsourcing sites record activity logs. Could these logs be used to identify how much information users can process and what is obscure or unnecessary information that hinders matching? If, based on this knowledge, a system could be created for conveying the necessary information in simplified form, it could also prove useful in the provision of offline information to job seekers and employers at, for example, HelloWork, a public employment service center.

Future Schedule

January 12 | The 9th Science Council of Japan Symposium on Informatics (Sponsor). For details and registration, go to the event information page at (http://www-higashi.ist.osaka-u.ac.jp/scj/symposium09.html).

January 19 | The 3rd SPARC Japan Seminar 2015 "The Potential of Social Media Services for Researchers" (provisional title, Host).

January or February | The 5th Industry-Government-Academia Collaboration Lecture, "The Development of Research on Material Perception" (Professor Imari Sato, Digital Content and Media Sciences Research Division). Date will be announced on NII's official website (http://www.nii.ac.jp/).

February 25 | Public Lecture No. 6 "Your Information, Whose Is It?—Personal Information and Privacy in the Age of Big Data" (Specially Appointed Lecturer Rihoko Kawai, Information Systems Architecture Science Research Division). For details and registration, go to NII's official website (http://www.nii.ac.jp/event/shimin/). Public Lecture No. 5 (January 27) canceled at host's discretion.

March 3 & 4 | Cyber Security Symposium in Dogo (Exhibitor).

Notes on cover illustration When the comments and actions of many robots are shared via a network and analyzed, they become valuable information. The illustration shows this exciting crowdsourcing scenario.

Weaving Information into Knowledge
NII

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