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Developing rehabilitation into a science, making BMI available to patients

Dr. Ushiba is devoted to research into application of Brain-Machine Interface (BMI) to rehabilitation. As an elementary school boy, he happened to find computing as a field that aroused his passion and was absorbed in it. Next, what caught his interest during junior high school days were wonders of the brain. Ever since, both fields of intellectual interest have become the interfacing guide for Dr. Ushiba's career as a researcher and are now beginning to take a concrete shape in his research into BMI with the objective that it will be made available for many patients one day.

As an up-and-coming researcher, you must be leading a busy and fulfilling life. To begin with, may I ask in what kind of family atmosphere were you brought up in?

I grew up in a family in which my father taught French literature at a university and my mother taught French conversation and did translation. It's a totally liberal arts-oriented family. As I saw my father spending much of his time

in his study, I came to feel that being a university professor might be an enviable profession. This yearning seems to be the beginning that motivated me into life as a researcher. (laughter) Against such a family background, I had always been told, 'You do whatever you like. But once you get started, do it to the very end with a sense of responsibility.'

What was the motive that got you interested in computers?

When I was an elementary school fifth grader, my school offered an extracurricular computer class. Several PC units were made available to applicants who were taught programming during after-school hours. At the invitation of a friend, I attended a session. This was the very first time for me to play with a computer.

During summer vacation, a Keio University professor opened a computer class on the Faculty of Science and Technology campus, which I also attended. I was amazed at several graduate students each writing a computer program there, which greatly impressed and motivated me. Since that time, I have been totally fascinated by the computer world.

In those days, artificial intelligence (AI)

was in fashion. One day, a postgraduate student visited our elementary school, bringing with him his program for an automated conversation system. It was something like a "Riddle" game. If you gave it hints one by one, the system finally responded with a correct answer. The fact that humans can create artificial intelligence was totally new to me. I was taken aback.

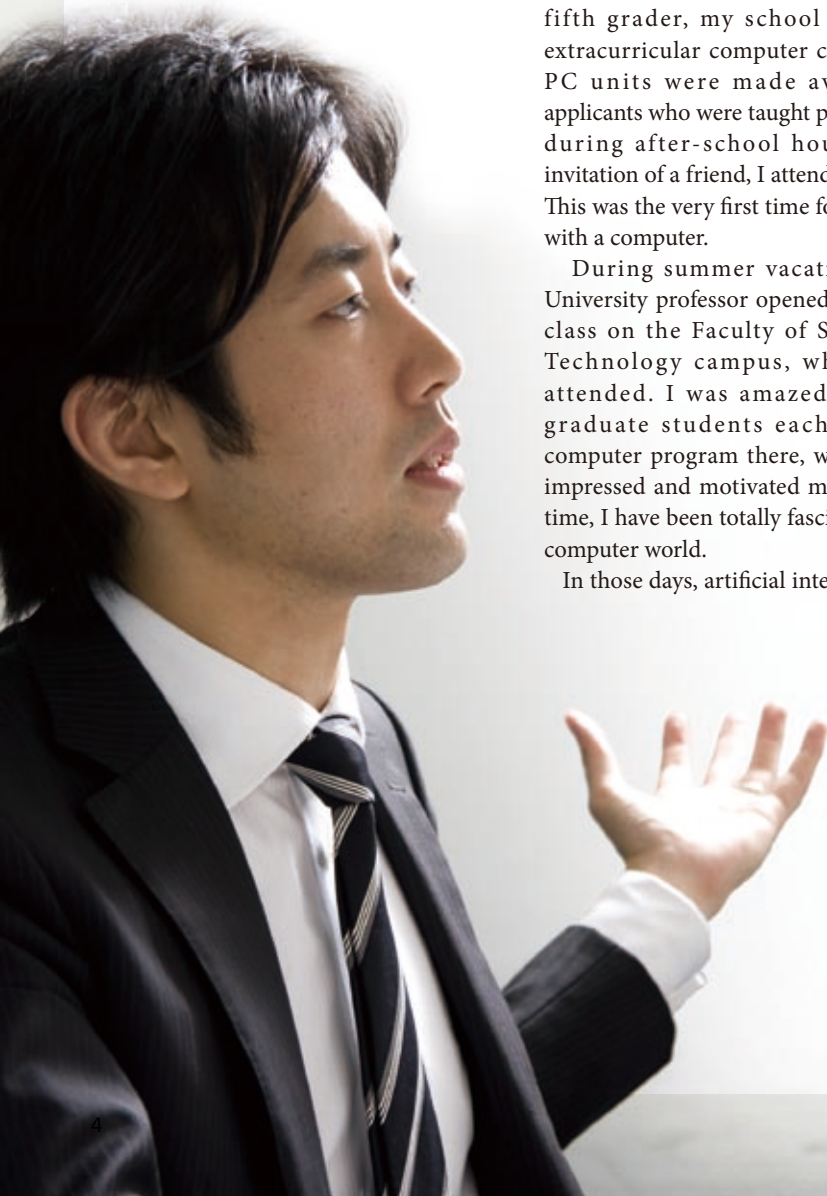
When I was a junior high school student, Dr. Katsuhiko Mikoshiba (now with RIKEN), one of our alumni, visited our school and gave a lecture about the brain – another first experience for me. He talked about brain enthusiastically and the content of this speech was also very attractive. Later on, I applied to attend a lecture featuring Dr. Gen Matsumoto (then with the Electrotechnical Laboratory), a celebrated brain scientist. Indeed, I was under the strong stimulus of these two scientists. For me, their impressions are still strong and vivid.

That is an age when various stimuli can come from various directions. Was it possible for you to carry through your interests?

Although I entered a high school with a reputation for computer education, I joined the brass music club where I played trumpet, and even formed a

Junichi Ushiba

He has been engaged in research on the motor control mechanism concerning human autokinesia and reflex. For the past several years, he focused on the development of Brain-Machine Interface (BMI) applying scientific knowledge accumulated so far. In 2003, he became a visiting researcher at the Center for Sensory-Motor Interaction of Alborg University, Denmark. In 2004, he obtained a doctorate (engineering) and became a Research Associate at Keio University. From 2007 to date, he serves as an Assistant Professor at Keio University Faculty of Science and Technology.



band of our own. The reason is that the computer world in those days saw the debut of Windows with a complex and hard-to-operate system, which spoiled my interest to some extent.

Meanwhile, I continued to cherish a strong interest in the brain. Pedantically I liked visiting libraries and bookshops to hunt up difficult-looking books. I sharply reacted to terms such as “artificial intelligence” and “artificial life.” I received strong impetus when I knew that a postgraduate student at the university campus adjacent to our high school was translating a recently published book on artificial life, saying to myself “Wow, such an amazing student is so close to me!” Artificial intelligence and artificial life can create functions intrinsically peculiar to the brain or life whereas the computer can do only what it is instructed to. Why and how on earth is it possible? These questions intrigued me very much.

As the university entrance exam season approached, I hesitated as to whether I should choose the medical course or science and technology course. Finally I made up my mind to choose the latter. At that time Keio’s Faculty of Science and Technology just added a new department known as the Department of Applied Physics and Physico-Informatics, which I chose and entered. This is because the department had a close relationship with the School of Medicine and there were professors specializing in neurology and the muscular system.

Though admitted to this department, was only in the junior year that I became really motivated to study hard. Instead of learning the basics merely as the basics, I came to understand that the basics are necessary because there are such-and-such fields of application, or “exits” you might say. This is how I became self-motivated for learning. I’m of a type who begins to learn the basics required only after I can identify how a particular field of study can be useful for society.

I joined Professor Yutaka Tomita’s laboratory mainly because Professor Tomita was engaged in research into rehabilitation and maintained a good contact with the School of Medicine. Immediately after joining the laboratory, I was lucky enough to be introduced to a Medical School professor and launch a joint research project.

You are a happy person since you could directly develop your interests and talent that had budded in your elementary school days, which became your calling. Don’t you agree?

I’ve had familiarity with campus life

partly because I was raised in a scholastic family and partly because I visited university campuses from time to time since my elementary school days.

Through such experiences, I found that universities are a wonderful world where everyone is doing creative work and both the young and the experienced are getting along with each other in friendly and liberal manners. This impression remained unchanged even after I became a university student myself. I was so attracted by the university that I found it as a place of my calling. Actually I didn’t stop even for a moment to look around for opportunities of employment with prosperous businesses.

A little over five years have passed since you began to teach at the university. What is your impression of actually having worked there?

It’s delightful to see my students doing good jobs in the business world. I feel extremely rewarded as a teacher especially when some of my former students tell me something like, “Your advice at that time was so precious and encouraging.”

On the other hand, I always feel a certain kind of difficulty because I’m always dealing with students – “humans.” There were occasions where my sincerity couldn’t be understood by students, which was so depressing I lost confidence. I know it’s not good if I’m too obtrusive when giving students advice or instruction, but there are students who want to be advised more specifically and attentively. Really puzzling, isn’t it?

Please tell me something about your projects in progress in terms of industry-academia collaboration.

My goal in the foreseeable future is to develop the BMI into a tool actually available for patients. So I’m teaming up with interested businesses to create algorithms for biosignal analysis and develop machines.

In what direction do you intend to develop your BMI research project? What are your short, medium and long-term objectives?

For the short term, my objective is to present, in a few years, evidence of the BMI for rehabilitation I’m currently working on. Rehabilitation is a new concept of BMI application. I’d like to

theorize the concept as a field of science and disseminate it from Keio to the world. While I expect certain progress in academic verification to be made within a few years, I think it will take more time before it can be applied to actual medical care.

For the medium term, I’d like to introduce brain science as the base of our project, while I also want our project to shoulder a part of endeavors to establish rehabilitation science. As you may know, current rehabilitation still depends much on experiential knowledge. However, this field is making progress toward becoming

“I’ll establish a new remedy by bringing to light the mechanism of dysfunction due to neuromuscular diseases.”

a systematized science, which I would like to be a part of and make a contribution.

My eventual goal is to return the fruit of our research efforts to education. Because our field makes it necessary to learn multiple fields of study in well-balanced fusion and to associate with people from diverse fields, I’d like to nurture talents who can do such things on their own. I think I must study harder. At the same time I’d like to see my students not only grow as individuals with “interface abilities” but also become capable enough to extend these abilities to connect to those of their neighbors.

◎ **Just a word from . . .** ◎

● **His secretary:** Dr. Ushiba’s weak point is getting things around him in order. Is it because his brain is too nimble for reality to catch up with, I wonder? When it comes to tasks, he gives me instructions gently and attentively. This reminds me of his smile-provoking image as a good Papa at home.

(Reporter & text writer: Etsuko Furukori)

For the full text of this interview, please refer to:

<http://www.st.keio.ac.jp/kyurizukai>