Shinichi Yuta

An interview conducted by
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with
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Q: If we can start with your name and where and when you were born.

Shinichi Yuta: My name is Shinichi Yuta. I was born in Nagasaki Prefecture in Japan, 1948 and but I was grown up in Tokyo. Then I graduated from Keio University, it's one of the private big university in Japan. And I studied electrical engineering and continued to study at the graduate school and got Ph.D. degree and '75 from Keio University. And so then I was working for three years at Tokyo University of Agriculture and Technology, located Koganei City in Tokyo. And then I moved to Kobe in '78 at University of Tsukuba. At that time, I was belonging to Institute of Electronics and Information Science. Then I already stay at Tsukuba 33 years. And actually the system has changed and also I moved to another institute. And now I'm working at the graduate School of Systems and Information Engineering, University of Tsukuba. And once I was working as a dean of the College of Engineering Systems for two years, it is for the undergraduate education of kind of applied computer engineering or, but something including mechanical engineering, electrical engineering or even architectural engineering. And also I was working as the chairman of the Institute of Engineering Mechanics and Systems for two years. Then I was appointed to be a vice president of the university for the research and international affairs and the industrial incorporation. And there I worked for two years there and I came back, stepped down to be a kind of a professor but working at a director of Tsukuba industry Liaison office it's kind of the center to stimulate collaboration between university and companies. And also something for teaching, education for other matters for the students. And then I was working for four years, now I'm very free. I forgot professor and okay this is my career.

Q: We're going to ask you go into some details about things that happened over time, so if we could way back to when you just started graduate school. You started university really, how did you decide to become an electrical engineer?

Shinichi Yuta: It's interesting question. Yeah, I was interested in mathematics, physics, as well I was interested in social sciences. But maybe my parents are not engineer, my father was working in company and he studied economics and working at a company and but maybe I am interested in other natural science, so then it's very naturally I decided to go engineering, because at that time I was studying at Keio High School, so then even at that time, it was some competitive situation for the examination to enter the university but because I was at the Keio High School, it's not necessary to take examination. So just I have to select which faculty. But at that time Keio University doesn't have a faculty with natural science, just university had electrical engineering and I'm not sure, but young boys science is more preferable than engineering usually. But still I'm getting interested in engineering and maybe I had no reason why electrical engineering selected. It might be okay to study in the mechanical engineering or chemical applied chemistry or even instrument or other department. But anyway, I'm not sure but just I selected without exact reason. So, then actually I enjoyed very much in studying the engineering, but also I was interested at that time on social science, economics or especially economics or such matters.

Q: Could you take classes or did you do things related to social science?

Shinichi Yuta: Yes, I took big class but preferably I just made the small group to study by reading a book.

Q: Do you remember any particular things that you thought were very interesting at the time?

Shinichi Yuta: No.

Q: I know it's along time ago.

<crew talk>

Q: Were there any particular social problems or economic kinds of problems that got you interested in thinking about the social sciences?

Shinichi Yuta: Actually, I don't have a particular problem or particular interest. But at Keio University used to be very strong in economic and also so not only by myself, but also the friends are also interested in the mechanics of society. So, actually the economy is one of the key mechanism of infrastructure of the current democratic society. So, and this feeling is not only the school but also my parents, my father give me some basic understanding of that. So, I was interested, for example, so then I was interested to know the more detailed mechanism or history or reason why we have such a system at that time. So, for me rather the mathematical understanding of the economy or social system or decision making was interested.

Q: And so you decided to stay in electrical engineering for graduate school?

Shinichi Yuta: Yeah, I like study, so but actually this is very interesting for me, this is very important event. And that when I was the final year, senior of the university, I myself supposed by myself to go some company and not the idea of exact company, I thought that I would work at industry, some company as not a salary man. I was working in electronic engineering, studying electrical engineering and I had no objection about that. But still, I didn't have any exact idea what I would do. But just I liked the electrical engineering theory, that field. And also another issue is I like to travel or I like to climb the mountain or enjoy the other people, friends. So then, I was thinking to extend the chance to enjoy, to travel something, the graduate school was a very attractive for me. And I thought that it not good idea I thought to go graduate school just for to enjoy. At that time, I thought so. So then, actually I thought that I will work in industry. But once my friend who is 15 years older than me, I was talking with him and he told me that I must continue to study at the university because when to make a rich life, most important thing is how good time I have. And especially in a young age or even if it is not effective or efficient or

anything, just to spend, even when it's waste, it's okay. Just have a free time, it's very important, he told me.

Actually I suddenly decided in my mind to go to Master program in the university and so then I sometime, I never thought to be a professional academia. But while I was not studying, I was enjoying in the Master program. I was recommended and suggested to continue to study at the Ph.D. program with some scholarship. So, anyway, get a scholarship is a good thing. And in Japan, at sometime at the engineering departments, even the Ph.D. program students, their parents should pay the tuition. And it was a private university so tuition is not small. But in my case, some program at the university provided me a tuition and scholarship. So, I decided okay. I will go to a track to be academia. So, but at that time, I thought that it is almost decide the job at that time. That scholarship is to keep some good potential student at Keio University but as it turns out, I am not that bright at Keio. So then, I start work at another university.

Q: Who did you work with when you were a graduate student?

Shinichi Yuta: At that time, Associate Professor Takahashi, he is a specialist of the electrical circuit and system theory. Under his supervision, I studied about optimization or electric circuit theory and engineering control systems and such fields. Principally theory and no mechanics.

Q: So no robots yet?

Shinichi Yuta: No robot. And interesting thing that, so about the robot. I was working at Tokyo University of Agriculture and Technology for three years and at that time, actually I thought myself that what I can do and but I thought that I got a theory, so then job should be assigned for me. This is a basic sense at the time. So, then I was working as a research associate and some professor who are doing medical application of the control, electrical engineering. So, special in the ultrasound diagnostic equipments. So, I did with ultrasonic imaging system research and development and also just at that time, the so-called computer tomography, CT started. We imported from EMI in England to Japan. So, first I visited some hospital to see it. So then, we did some research of the imaging but not only the results on imaging, but also the CT imaging for the medical application. So, actually I enjoyed and I did some research collaboration with medical doctor in Osaka, but anyway my profession is research associate so I thought I had to, even though it's a tenured position. But anyway research associate itself is not a good position so I applied by chance to Tsukuba University so then I moved to Tsukuba University after a few years. And also, I continued to work in medical imaging. So, actually still I am proud of that. I am one of the first researcher of ultrasound computer tomography in the world.

Q: What were some of the early challenges in medical imaging?

Shinichi Yuta: Yeah, to make a good resolution of the image. To provide a medical doctor can diagnose, especially in the cancer. For example, at that time, the key was how to find the cancer one centimeter in the body. So, actually I enjoyed this development but after moving to Tsukuba University, I thought that for me it's okay. But for the students, such a medical application is even when we make some good theory or methodology, but the variation of this methodology can be done only by medical doctor. We can say that, oh this is, I tried to get convince by medical doctor, but medical doctor sometimes very like our results and sometimes not. So, we cannot decide this is good or not. And the other side, for the – so then one method to solve this problem is I study the medicine, but I don't have a big interest in that. Just I was interested in the technology side. So then, at that time, I decided to apply my experience of technology not on the medical but rather to the industrial applications. What that thought I had when I moved to Tsukuba from Tokyo University of Agriculture and Technology.

So but, just after moving to University Tsukuba, Professor Kameyama is not my boss, but I worked together with him and he's ten years elder than me. And he invite me to join to research on the mobile robot. So then at some time, at the University of Tsukuba, you know in Japan, we had chair system. So, very strong professor have several associates, it was a system, usual system at that time in Japanese universities. But in Tsukuba University, it's very like American system. So, I moved to Tsukuba as a lecturer, but lecturer, it's a kind of that assistant professor really. And even the lecturer is very independent. So, I have to manage everything by myself, but I cannot force. I was not forced by other people to do anything. But still, it's not bad to make some group. So, Professor Kameyama invited me to work together on the robotics. Not on that mobile robot. And but at that time, I didn't think that I do the research on the robot. But he invited me to work together to develop some small mobile robot for the students and other students project.

So, to participate micro mouse maze contest. It was just started and it was the one of the target contest was I suppose, I'm not sure, anyway, in the UK. So then, I'm not specialist on the mobile robot and not specialist on the video circuit system but still I feel some interest and I thought it's a good chance to study for myself. But, so I just study of the motors or circuits or computer and software with students. So then, it was fun and what most interesting and most exciting thing for me was I was an instructor-teacher, but together I work with students and all at the same level because some of them have some experiences and I didn't have experience. So but, actually I knew the theory of control or circuit or some basic structure of the software so then I can give them a very good suggestion in to working with the other. So then as a result, it works, not completely, but something it works. It gives me a very big impression that. And this such a thing is very good thing for student to study and I can have some effective work for them.

And also and most important thing at that time for me, is when I was at graduate school or especially when I was graduate school, when I doing the theory, I just make a paper. And at first we say that recently, some requirement from industrial or something like that. So then, such a kind of constellation is necessary then blah, blah, blah. It's a style of writing a paper but I

didn't believe that. Actually I didn't think it's true. But I was forced to write and I thought that this is a manner, just a manner. But so it's a manner, so it's okay for me, but I didn't think that I don't wish to force the student to do technical writing. But in the case of robotics, it's not a paper, and also for the robot it's very clear let's make such system to work something in such environment. It's very clear to understand and I thought that it's possible to have a same direction, same purpose, same mind with me and with the other professor and with student.

So, I thought that this a very, very good subject to other research, very, very good research subject in case to do at the university as a part of education. So, actually, at that time, I thought that I'm getting salary from university for teaching, I thought, not for research. So, then it's very natural for me to select research subject for the education. So then, actually at that time I thought that this is a very good subject for education. So, then at the other side, in this point of view, to make a paper, the efficiency of, the productivity of the research paper was not good. But actually, it does matter. Because I was working medical imaging and I had another group, I was involved in another group some company and Keio University research group and I still be involved in that group. But they write many papers including my name. So, the research paper is a kind of automatically made in this project.

So, in the robotics project, it's necessary for me to produce a paper just for me, just to give a good information for student, good subject, good chance, good opportunity for student is the purpose of my own involvement in robotics. That's the reason why I started the robot. So, several professors, especially in Japan, some of them are very much interested on robotics from the childhood. But I never interested in robot when I was child. Just I started to be interested in robotics as a standing point of teaching the student.

Q: That's really interesting because now people talk more and more about how important robotics is for education in these kind of science and technology fields. It's really interesting that you have that insight so early. What kind of robots were you using? What kind of technologies did you have to put the robots together?

Shinichi Yuta: Yeah, at that time, just electronics. But including how to rotate, how to control the motor. So, what we did is small size mobile robot is two motors, two wheels. And actually mechanics at that time is made by other and not by me. By other people or other students and after the control using the kind of controls something theory including based on the knowledge of dynamics is my theory at that time already. So, actually then I thought robotics is a very good subject even the research subject doing in university. And at that time, I thought that when I was studying to work at the University of Tsukuba, I thought maybe several years, three, four, five years, I will work at the university. But I don't have a reason, but I at that time, in some feeling, I thought that I will move to industry after several years. But I thought that in this case, I will do image processing or circuit design or control or mechatronics or something or even artificial intelligence. But I will not do robotics, because robot is a very good subject for teaching, but

robot is not good subject for to make money. This is my understanding at that time. Still I don't think so.

Q: How long did you continue your involvement with robotics for teaching and how did that develop with your interest in control theory into more research?

Shinichi Yuta: Still, I'm interested on the robotics situation with education. So, but eventually, gradually changing because I recognize that robotics itself is a good subject, just only for the scientific research. But anyway, as a university professor, I do something by myself but more important your major work by myself is supervise the student to do research. So, give them subject or suggest a subject, discuss a subject and research contents. But what I'm doing as a research is not done by myself, rather at least work together with the student. So, then after three, four years, then I recognize that I can some research paper in the robotics field and it may make my career.

Q: What made you realize that?

Shinichi Yuta: Just I really got some interesting result, but anyway, for the students, they have to write a graduation thesis. And also, in Japan, we have many domestic conference. To publish a paper is of two pages, for example, and principally it doesn't have a review. So when we have some good experience, we have some good consideration, then we write a paper and sometimes it's the companies are interested in the result. So naturally, we start to write papers. Then if we have a rather more good result, then submit a paper for the honor, intelligent conferences.

Q: What were some of your early interesting results?

Shinichi Yuta: It's a difficult question. Actually, as a research point of view, I was interested in autonomous mobile robot, autonomous navigation. Say our autonomous mobile robot to go from my lab to another place autonomously. And this is very simple subject, but it's very clear and so then, for example, so such kind of the definition of that task or mission or whatever it's very good way to have common interest between student and myself even or another visitor.

So then, I decided as a research subject to realize autonomous robot to move some other place autonomously and how much reliability it has. It's important and to make the robot to move in the real world and so I cannot control the environment. So, it should move in the real environment. So but, I cannot control the other environment, so the 100 percent of the reliability is impossible. When that day happen when the robot moving, so the robot cannot arrive the destination. So, then how to increase the probability of successful ratio is an important issue. So, to define a more difficult environment or more long distance is we change the subject to more long distance, more general environment, but still very definitive problem between for example from our lab, the goal of our research is to put our automobile robot at some park at

Tsukuba City. It's eight kilometers from our lab and fortunately we have a pedestrian street in Tsukuba City. So, the story is the robot should come back autonomously from there to my lab.

So, when we put the robot, push the start button and come back by myself at my lab and it's eight kilometers so after two hours robot came back to front of my room. It's a story, for this purpose, actually we had too many things to do for the environment recognition, even just the sensor issue or electric circuit, electronic circuit power, motor drive or management with a battery, everything. So, I thought this is not a good definition of the project. So usually, when I told at that time, it was more than 20 years ago.

Q: So, this was the early eighties?

Shinichi Yuta: No, mid-eighties, no, end of eighties. So, after that time, I usually tell that our goal of the research is to realize such an autonomous robot. It can come back from Doho Park to university autonomously by itself. That the people from the newspaper or media very much interested and asked me when it is realized. So, then I usually answer oh, age 30 years, wait, 25 years, recently I say oh, 85 years. Anyway, always after my retirement, I don't have a responsibility. It's a story. But actually 20 years ago it was just almost dream but I thought that we have some certain possibility to realize, but now I can say that. It depends on the project.

Q: Did the robot have any accidents?

Shinichi Yuta: Yeah, of course, even the people may have accident. So, the program is to just increase the probability to come back safe. So, the 99.9 percent of a probability, it's okay. But usually, besides people say that. We success this motion, this reaction, this behavior, but the success ratio is best on 10 percent for example. So, to move autonomously for a longer distance, it's a key, because in case of the success ratio of navigation in one kilometer is fifty percent, then the success ratio of ten kilometers is less 0.1 percent. So, to realize longer distance, it's very simple explanation to realize the high reliability. So then, actually recently, five years ago something I gave up to realize by myself, but I realize the Tsukuba Challenge. It's a kind of open experimental event to make one kilometer autonomous navigation in Tsukuba City and other people are moving, working, bicycle is moving.

So, in Japan, we have more 70 group participating every year in these years to try to realize such an autonomous navigation. So, of course, the team from my group, my lab participate and sometimes success and the other side. But anyway, to realize eight kilometers including observing go stop signal or some other steps or something, it's not completed yet. But, this is the kind of research purpose. So, it's okay for me. Another interesting thing is to come back from Doho Park to University it's eight kilometers. It's just same distance from Shinjuku, do you know Tokyo? So, it's eight kilometers. Of course, it include many street, but if the robot has mechanism to climb up over street breach, then the difficulty's almost the same, I guess. It's

a rather big subject and to maybe good for to understand. Not only the researcher but also the student but also by the newspaper people or any people.

Q: What were some of the different approaches and different robots that you used while you're trying to solve this big navigation problem?

Shinichi Yuta: Different, you mean, for example original thing or very different something. I don't like it. We have to find a good way, if some people propose a good idea, then we should use that. So, actually in my theory, our methodology is very simple and almost obvious method. So, principally no special idea. It's my own theory. But still, we believe that a kind of a position estimation is important and estimated position based control is also important. And some kind of the quantitative map expression is important and quantitative understanding of the sensor information important. So, it is not special, but to realize such a system and we have many experiences on that. And so the technology about that, we actually believe that we integrating the technology. So, the companies, I have several friends with companies who are interested to know our experience.

Q: So, it's really a question of putting all the different systems together and figuring out how they're going to interact to make the robot do something?

Shinichi Yuta: Yeah. And, of course, not only this subject, we have many student in my lab now, 40 members we have including the major part is the Master program student. After getting Master degree, they will work in industry. So, how to give them a good subject to study with is very important. So, we cut something from this program or find some relating problem to give them to work together with them on some research. And also some other application of related work for the construction machine it's also done. But relating with this subject is a key of the research theme of ours.   And then, it's a mobile robot autonomous navigation issue, SLAM very important issue.

SLAM, the concept of SLAM is how to relate the human understanding of the geometrical environment. To make a map and localization, to do it together concurrently is a basic idea. It's a very interesting subject. But the other side to just realize such a robot, if the robot has no idea of the environment. So then, this robot cannot come back because the robot cannot understand the destination. My idea we can give the map or environment information as much as possible, but possible is important because for the student, in case we make some system, we will give the information as much as possible, but possibility is just one under one week for example. Then another date, efficient information is very important. But anyway, we give the information. So, not making map, but rather using a map for the localization is more important. And to make a map is another issue. It's to make a map in very efficient way is also important issue. So then relating with SLAM is very interested and common subject.

So, the word SLAM started, it was beginning of this century, yes. And I feel myself that I was working together with another researcher, I was observing the start of the SLAM. And also before we invent a word SLAM, this subject is already existed. So, one of my colleague in Japan did research to make a map using some vision in some constrained environment and using this vision and make a map and estimate its own position to extend the map. His Ph.D. but he got the Ph.D. in maybe '90. And historically maybe <inaudible> thesis at last is some issue, I think.

Q: Who was your colleague in Japan, who did the Ph.D.?

Shinichi Yuta: Okay, first Igima, so actually such issue interested and then usually we use electrical sensor from the first because it's a most simple and robust and easy to get at the university. But, the shortage of the environmental recognition, environment sensing ability, we did some research to realize more good autonomous sensor, the problem is wavelength problem to make a good resolution. So, obviously electrical sensing is better. So, we did vision or another sensing, but as a part one of this sensing, I used something collaboration with a company, optical range sensing, so then by the proposal by that company, I collaborate with them and helped to develop Hokuyo sensor. And Hokuyo provide small size of scanning range sensor and now it's a very famous and very much used in the robotics research field in the world. I some observation, I, from outside of myself, the biggest contribution is the development of this range sensor. But the reason I'm involved in this sensor is I was interested in autonomous navigation and I knew that the necessity of this type of sensor.

Q: Did you also do biologically inspired navigation?

Shinichi Yuta: Probably no. Actually, to realize good navigation system, to study how the human do it gives very good information. And also, not only the human but also how the dogs or other animals doing this task. Usually gives a very good information, we don't have enough good way other than thinking a human or animals. So then, actually we think in my case what I observe or what I think is I usually analyze about myself, the human. To understand a human behavior or human thinking is out of my interest. The purpose is just a kind of a methodology. This is interest something about myself, I like animals. I like biological matter. So, once I had 14 dogs at my home, 8 cats at my home, I had a goat at my garden and almost 50 chickens in my garden.

Q: In Tsukuba you must have had a bigger house?

Shinichi Yuta: Actually, I have a rather bigger garden. I enjoyed very much with animals, but when I observed animals, I usually think that it's almost impossible to make a copy of them. But the other side, we can apply our technology to make some useful machine. It's rather lopsided of a thing. So what I'm doing is research, just I'm enjoying to observe or interact with animals. For example, I have, at this moment, of course, dogs died after ten years or fifteen, twenty years and

a chicken was taken by the small natural animals, so fifteen chickens disappeared for half year. But now, I have in my home we have three kitty cats and three dogs and one cat doesn't have an eye because of the injury, we removed his eyeball. So, he cannot see by eye. But he can survive, that he living very usually, looks no problem. Observing such action is very, very interesting and from the point of the robotics researcher, so I sometimes analyze what kind of sensor is most effective on them. Well, also such a flexible soft mechanism or body looks very important. So, I can explain something on them from the viewpoint of robotics research. But I have no idea to apply them as authority or such idea to my research.

Q: When you mentioned the Hokuyo sensor and that it was very popular, could you tell us just a little bit about why it's so special and why it was so useful for robotics?

Shinichi Yuta: Yeah, do you know Hokuyo sensor?

Q: Mm-hmm.

Shinichi Yuta: Actually, we already had the similar sensor by <inaudible> Corporation or other some companies. So, the big difference itself is a small size lightweight. And withdrawal cost and the other side, just from different point of view, the experimental base robotics research in experiment is very, very important. To know that your problem, even to know the real problem. But to realize a safe experiment, the small size platform is very important. So, then small size platform, for the small size, the bigger, heavy sensor is not good. So, maybe the point is optical range sensing, I will tell about why the optical range sensing is useful but comparing with previous, existing optical sensors, Hokuyo sensor is small size, small weight and low cost is a key. And so for this purpose, Hokuyo develop some new methodology in the sensing measurement technology. But the function itself is almost same, just small size. Even now, of course, Jeek has a very good technology, so I think there is no good idea to overtake already existing good system. What Hokuyo did is limited the distance of measurement and principally limited the distance of measurement. Then they developed was new methodology for this specification and realize a very small sensor. It's less than 200 grams and so it's almost one-twentieth comparing with the Jeek sensor. And next is effectiveness of such optical range sensing.

Anyway for the robotic application the shape of the environment is very, very important to move. So, for example, stereo images a depth map and gives, of course, shape information, but in case of the talking about a shape, the resolution or accuracy is also important. So, for the robot to move in such an environment, maybe they don't need one millimeter accuracy. But ten centimeter accuracy is obviously not enough. So, to realize one centimeter resolution or accuracy is reasonable requirement. So, then to realize one centimeter accuracy or resolution in ten meter or ten kilometer, five meter, ten meter, twenty meter region is most useful information for the mobile robot or even when manipulated. That reason we people use this sensor. And

then some strong point of the Hokuyo sensor is a small weight. Low cost, small power consumption.

Q: And you mentioned that you've always been interested in industry and that you worked with a number of different companies. Could you tell us a little bit about the different companies you worked with?

Shinichi Yuta: Actually, the basic idea, the funding is the most important issue, usually. But, I'm very happy, I'm getting salary from the university and in Japanese university, university provide a small amount of money for research. Not enough and also I can get fund from Ministry of Education Science Education Japan as a science research grant. So, then the funding from industry, especially nowadays, funding from industry is not so big part of our research support. Still, I believe that what we do our research, my main purpose with research is education. Using this opportunity, the second purpose with research is apply our result to help the industry to make something for their own purpose. Maybe that is write a paper to be famous in the world or something. So then, I'm very happy to give any information to industry.

Sometimes, it's better to give exclusively our experience or technology or sometimes it's more effective to give any company. So, exclusive transfer, the purpose is how give them information or technology is used, how much it is used is important. For this purpose, sometimes we open it, sometimes principally open all the information. But sometimes we keep some special information exclusively for this company. In this case, when I think that this is more good to be used. In this sense, it's not for the financial support. Fortunately, we can get money from government. So, we should give them the research for the society. It's our duty. But this is one of the point for the communication or cooperation with industry, but the other side, for me, more important thing is our student, in my class or in my lab will start work in industry. So, teachers, professors should know what kind of technology is required or what kind of technology is necessary for them. This is very important information. So, for this purpose or for to decide subject of ours, also important information what they are interested? I actually I feel I need the information of the companies. So, to get such information, we have to have a very kind of a close relationship or a friendly relationship. This is more bigger purpose for myself to communicate with company. But when I just tell or wish to know what is your problem, what part are you interested, the company will not give good information. So, to make some give and take relationship, we should be able to provide some good information for them. So then I use our research result to provide them as information to make a good relationship.

But important purpose is get the information from the company, necessary information from the company to teach the class to give the information for student. So, for this purpose I'm very active. I'm always trying to make a good relationship with these companies. And of course, it's fun when our result is used by company, but usually it's very difficult. But still, many company has interest on the research result of the navigation or just the motor control or autonomic sensing or just a motor drive. We have many things we have so we provide them. So

when I contact with the motor company, then we tell them what we are doing related with the motor control or how the motor is used for something. So, we will give them a very detailed information about that. So, then I usually ask this what kind of student do you wish? Or when in case a student working in company, what subject they should have studied or what kind of research do you wish us to do? I ask them.

So, actually one company just produced a copy of our motor drive circuit. It is not a special one, but for them even as the circuit and the printed pattern on the circuit is working in this condition, such information is very important. When they wish to make some special purpose motor driver, for example, so we provided the circuit information or source code of the many parts of the subsystem of the robot. And also, we gave information of our navigation system for the security guard company for developing security guard robot. And also once Mitsubishi Heavy Industry made a wakamaru robot. When they announced the first announcement in newspaper they said that the vehicle control part software is produced by my university. This is the reason why we just provide them our source code and explain very in detail. Unfortunately, they give not any money for me in budget. They are very pleased and they promised me if necessary they will think seriously to provide research budget for us. But at that time, also they have a problem with shortage with the budget. We are very happy because it's kind of in the budget. So, I thought that if we have a problem with a shortage of research budget, maybe then I will ask you, but unfortunately, he moved out of the section.

But anyway, I got very good information what is a problem of them and what company requests of students, so actually I am proud that my graduation students, not all, but very good part of the students graduated from my lab, especially in the Master program, to working in the Honda, Toyota, Hitachi, Mitsubishi, any company. They are getting a very good evaluation, I believe. This is a relation between company and myself.

Q: And I mean having students in the company also probably makes you closer to the company as well, you have more connections or no?

Shinichi Yuta: Not much. Some of them we have but so yeah actually kind of the contact person of the company I have several companies, maybe only one-third or less company in 20, 30 person company the contact person is our graduation but it's not usual.

Q: And what are some other companies? You mentioned Mitsubishi, and Hokuyo. What are some of the other companies?

Shinichi Yuta: Other companies, Arisaka Security Company, <inaudible> or I'm not sure I can tell you or not.

Q: That's fine. Only the ones that are okay to know. And so when you –?

Shinichi Yuta: But the other side as a result I sometimes ask the company to support the budget, not as a contract, just by donation so in this case we don't have any obligation in this budget. Still then it's very free to use, so this is very, very good money. Amount is not much but such a donation from the company makes me very big freedom of the research activity.

Q: And I also noticed, I was just reading one of the kind of bios online for you and I noticed that you were interested in modeling the evaluation structure of Kansei.

Shinichi Yuta: Kansei yeah.

Q: Kansei is a very kind of specific term for Japan so I was wondering if you could tell us a little bit about that.

Shinichi Yuta: Okay yeah. Actually it's not my own interest; it's not my own interest. Rather one of the famous researchers who is doing industrial design in our university. He did not only industrial design are usually kind of the artist but he thought that not only the artistic thing the other or technical thing. Even artist should understand about the audience or even when he draw the picture. Usually the artist just draws the picture, that's all. But nowadays even the artist should know, should think about the people who see, who enjoy this picture. So for this purpose the artist or more principally the designer wish to know the how their design picture observed or how they are impressed by some people in as much as quantitatively. That was his interest, not my own interest.

So then he requested me because we are rather some good friend then he requested to me to join his project to use robotic interface as a tool of measuring the user. So actually for example then what we did is we develop robot who are which is remote controlled to move in the floor of the museum to get the image to send the people. Who are enjoying this museum remotely. So just provide such a system using your technology web as a communication path. And this is a simple idea or application of the mobile robot, but the real purpose is when you we use remote mobile robot as avatar myself to move in the museum, art museum, then we can decode the look or the motion, or how many seconds, now many minutes stop on the picture or which path of the picture is observed. So we discuss with this professor of art school and industrial design that we can make such a robotic system as a tool of the measuring of the audience interest. So he is very pleased and interested.

So we did it some and as a result I have to be some kind of a spokesman of this result from the point of view of the technical side. So then and so it was one of the university projects so I had say, I had to say that I am doing the concept project. That's all is. But actually this is for me. This is relationship. It's of course it's as interesting for us to apply our technology and our technology is used but it's a kind of the user robotic or usable technology is not only the industry but also I found user technology inside of my university.

Q: Who was your collaborator?

Shinichi Yuta: Okay Professor Harada Akira. He is now a president of Sapporo Municipal University.

Q: But I've heard also in Japan Toyota also talks about Kansei design.

Shinichi Yuta: Yeah.

Q: And in Waseda they talk about Kansei with robotics.

Shinichi Yuta: Yeah.

Q: Very much.

Shinichi Yuta: Yeah, actually so Professor Harada initiated the Kansei – Academic Society of Kansei Engineering. But this word is not invented by him himself. This word is a bit old but Professor Harada is one of the key persons of Kansei engineering. It's so this project is also advertised in several places but Japanese people, many Japanese people are very much interested to treat Kansei.

Q: Why is it, because it's a very different perspective on engineering in a sense from the efficiency rationality kind of way of thinking?

Shinichi Yuta: So but my interest is engineering principally, but also my interest is engineering but my interest is also the how our product by engineering it's used in the society. So then he should know what's a problem, what's a requirement, what's a real purpose to use our technology? So Kansei actually this is not usually it's not my own research subject. Just I wish to know and I try to understand. But in this project I could observe more detail how our technology is used for their purpose. So then I collaborate some something more deep in this project but again my own basic interest is not that part.

Q: Were there any surprising results?

Shinichi Yuta: Oh, principally actually for me it was many interesting things but main thing was rather give the – a kind of the foundation of the fact which are already imagined. For example the in the museum, picture museum there is a small explanation card under the picture. So the people in the museum how would you say the people the specialists working in the museum use –

Q: Like the museum curator?

Shinichi Yuta: Yeah, that's right. They have experienced that. It's a bit easy to change the flow of the people by explanation. But still they didn't have any exact numerical comparative decode how the people move or something like that. But actually using this our system as a tool of the measurement of the audience they can get some information about that. So it was very, very much interested by themselves. I was very much interested on the fact that this is interested by them. So it's interesting.

Q: Are there any other projects that you want to mention or things that you'd like to mention?

Shinichi Yuta: Yeah, recently I as I told you, recently, this five years I am organizing a special Challenge. It's something similar with Grand Challenge operated by DARPA. We just provide the course and the subject for the mobile robot, the autonomous mobile which moves the pedestrian street and the city plaza or park or the center of the city. One kilometer and the robot should move autonomously completely autonomously from the start point to the destination. While the user people moving, standing who are enjoying playing. So autonomous mobile robot should coexist with for example the wheelchair for handicapped people, or bicycle, or children.

So – and this the but still the basic point is how to navigate reliability from in this course and we call and we call it to all in Japan so many researchers in robotics even the companies are interested to participate. And what I provide is opportunity to make experiment. So I work together with Tsukuba City local government and I get permission from the police and but to organize experiment in the same day for all people it's very good opportunity for them to observe each other or discuss. So actually in Japan this year 50, 60, 70 robots were developed to come to participate in this technical event. And big difference from the DARPA event challenge is this is not a competition. Just open experiment to work together so we don't give any order. But the people can observe that this robot completed the navigation. And this robot could not complete it but this robot could navigate autonomously after this point, 500 meters or something. But anyway we don't give any order. It's not competition, not prize, not budget support.

Q: One thing I've noticed in the past looking at competitions, mainly business plan competitions are the ones where the prize gets higher the more the teams don't talk to each other. So I'm curious if you've seen – so this sounds like you want to encourage conversation.

Shinichi Yuta: Yeah.

Q: Have you participated in other competitions where they are very competitive? Or do you notice some of this philosophy behind what you're –?

Shinichi Yuta: Actually principally I don't like competition.

Q: This is a great idea.

Shinichi Yuta: But anyway in the case of robots, if we teach competition, still it's very easy to observe. So how this robot move? What kind of sensor it use? But rather provide them opportunity to discuss. If it's a really competition to get some prize then they do not wish to tell their technology. But still I believe that the autonomous navigation is it's a very long years' history of technology. Still it's not enough to realize. So the common understanding is very important. But their robot system, the paper by itself is it's of course it's very good information but it's a bit limited to just to see or just discuss on the front of the robot, it's very important. So actually thank you very much. It's not the – it's because it's not competition then we can have a very good opportunity. But the other side, it's partially it's not a competition. Still the not only the definition but also the safety purpose. We have to decide the details of the course for example or a kind of regulation. But to make regulation it's very difficult. And anyway it's real world. So first robot move in some situation. When the second robot start it start to rain. And in the case of third robot there come another cart.

Q: So the environment changes.

Shinichi Yuta: So the environment should change. But in the case of the competition organizers should provide some equal condition. But this is nonsense in the problem of the real world. But anyway we have – but still we have to give some regulation. But it's very difficult to write the regulation. Then I say that regulation is me – please ask at any time on site. But then but some people from abroad interested to join. Then ask me to send the regulation. Of course we have some, but it's very difficult to write a very detailed definite regulation. So we decided just a regulation is written in Japanese language. And because for us this regulation should be understood by the local people. Not for the specialist. So then unfortunately or fortunately we this challenge is just for Japanese people. But anyway we don't pay any budget. Rather we get registration fee but we don't pay any budget, but registration fee is not so big. But the people should bring their – should develop the robot by themselves and should bring robot by their own expense to bring to Tsukuba to make experience and discuss this together and bring back. And there actually this is a very – I believe this is a very good opportunity and I'm very proud that I could provide such a chance for the desired robot researchers in Japan.

Q: What do you think are some of the future challenges for robots in Japan?

Shinichi Yuta: Future challenges? Yeah. This is just name is Robot Tsukuba Challenge. But I think of course it's a kind of a challenge but I don't think it's not a grand challenge, not grand. That such opportunity is very important. It's my own mind. So the actually the challenge of the robot is very difficult. Anyway we are challenging to make some good machine which can walk like people. But actually the when we define that task, then it's better to make single-purpose machine so the <inaudible> the grand big challenge is to realize a machine which can walk various wide range of tasks in one wide range of the environment. But still wide range is it's not

clear but it's very difficult so for example for me for example to realize the small size mobile robot which can behave just as the same as my cat. For example walk around in the room climb the tree and at anywhere around my house if you can come back to my home to eat and he can recognize people and he can recognize a car and avoid – escape from the – usually he is sleeping on the street because in front of my house traffic is not much. But when the car come he is usually wake up and come back to my home or something like that period.

So to realize that such cat's behavior is very interesting subject or a very interesting target of development. But it includes too many challenges. And also but the other side I'm very much interested, but when I give you the proposal over this development we use a very big budget. I will refuse because this subject itself is not worse to use the tax. When I have a very rich man, I have many money I provide then it's okay. This subject interests me. But from the viewpoint of the <inaudible> project or something I believe that interest more important is not interest usefulness in the society.

Q: What do you think are some applications that are going to be very useful for society?

Shinichi Yuta: Yeah, then application point of view actually for example the most successful robotic machine in the world first one is automatic clothes washer. Imagine 50 years ago the people should wash their clothes by hand in cool water even winter. But that's and usually in Japan maybe in other country washing your clothes is a task of the woman. So it was very, very hard work. When we in the case if the people say the washing woman or you 50 years earlier after 50 years you just put your wash in the box and push the button and just you can wait the machine call you after washing and rinse and dried until you can just see it and watch picture or drinking tea. In this when this woman will feel that no I cannot imagine such perfect robot.

But nowadays usual people have their own robot washing woman robot in each home and also but it's just small box. It doesn't move. So next generation washing room machine will walk around the room to find clothes when I just removed clothes and throw it, then washing robot come to pick up and wash and fold it to put on the place. But at this moment we can never consider such a system in practically. But so I'm not sure such washing robot realize or not. But also another robot system is power shovel, excavator. It can move. It can dig the soil or do many other things. Of course it's control but recent excavator is very much automated. Of course operator is necessary. But it's very easy to operate. And sometimes we can control it remotely so it has a hand. It is a mobility to work what people usually people doesn't wish to do. Very hard work, it can provide. It's a real robot but we don't say it's a robot. Washing machine, right, we don't say it's a robot because it is really useful.

So when for example in iRobot series the Roomba cleaning robot, but at first people feel that it's a robot. But nowadays it's just a cleaning machine. So if we have to say it's a robot then it not only cleaning the floor but also I wish it should for example when it finds something on the ground if it's a robot it should pick up this mobile phone to put on the table or any other it's

requested to do if it is robot. So at this moment the cleaning robot our feeling is it's not a cleaning robot anymore. It's just a good cleaning machine. So in the application point of view I believe that. In any situation or any system and a robot technology will be installed in a very wide range. To realize more good performance of cellular phone, electric pot, or even a light or camera or anything. Of course in the automobile so the robot technology will be installed to make it more good performance. But after realizing that they are practical, reliable function maybe we will call it this is just a car and even a good car.

For example 50 years later if the taxi in San Francisco usual taxi doesn't have a driver, just it's a normal operated automatic car just but service area is limited only 20 kilometers or something. Still it is very useful taxi and in such a case it's very good because one more people can ride. So at this moment it is actually it is robot but if we have such a system then we will not feel it is a robot. So this is my definition of robot, so that robot is machine, it's a good technology in dream. So what are you doing to realize the dream? But in this sense sometimes I explain that what we are doing is that we are developing machine good machine which is thought as robot now to be just a machine, not a robot. From robot to not a robot is our work, what we are doing. So then the develop a robot it's kind of that means develop a prototype or something. It's my feeling. So it's very difficult to say grand challenge. <laughs>

Q: Grand challenge means there will be no more robots ever.

Shinichi Yuta: Yeah.

Q: So just one final question. We want to have an education component for the website so we just ask everyone do you have any advice for young people who are interested in studying robotics?

Shinichi Yuta: Yeah. What I'm talking with students who are young people, just think what do you wish to do? Just think what do you wish to do or what are you interested then try to realize your interest. It's usually I'm talking with the students but this is a reason why. The reason is I didn't have such a sense when I was young a child so I thought that it's rather better for me to have some purpose or direction. Especially in Japan, especially in Korea or China the purpose of young people is just by examination. So my feeling is by examination is not a good purpose because I don't like competition. <laughs> So what I should say is that try to do a practical, try to do practically and what you wish to realize or what you are interested and integrate many experience is important in the young age. Of course a kind of good consideration or thought is also important but my feeling is more experience is important.

Q: Thank you very much. I hope you're not too tired now.

Shinichi Yuta: I enjoy to talk.

Shinichi Yuta: So but point of view, my point of view, robot cannot be understood because if it's –

Q: It's always in the future.

Shinichi Yuta: Yeah.

Q: That's a great point of view. Yeah, I hadn't heard that before. I haven't heard it put that way before but that makes a lot of sense because there are – you get used to a certain technology and it becomes normal and robots are not normal things. It makes a lot of sense.

Shinichi Yuta: But also from the point of view of academia who are interested to start up a very big project getting a budget from such a sector, some professor told me "Don't tell."

Q: "Don't say that." <laughs> Yeah, no I mean it makes a lot of sense because nobody can really define a robot. It's always very vague but everybody has – the public has an idea, roboticists, professors have an idea, everybody has an idea and everybody is very excited about it, but it's always moving.

Shinichi Yuta: Yep, that's right. Yeah, so robot can be defined by any people. For the element that is <inaudible> who can just make a box, add some hand by some branch connecting it by band he can say this is a robot.

Q: Definitely.

Shinichi Yuta: He can say but we don't say this is not my favorite robot. That's all. It's not. Okay. Thank you very much.