

# **From Margin to Center: Reframing the History of Women in Computing and Information Technology through Oral Histories**



## **An Oral History Interview with Wanmin Wu**

**Conducted by Bethany Anderson via Skype on February 9, 2018**

**University of Illinois at Urbana-Champaign**

**Transcription by Alicia Hopkins**

**University of Illinois Archives**

**University of Illinois at Urbana-Champaign**

**Abstract:** Born in Chengdu, Sichuan province, China, Wanmin Wu received her bachelor's degree from Zhejiang University and PhD degree from the University of Illinois at Urbana-Champaign, both in computer science. Wu is currently a software engineer at Google, where she works as part of the YouTube VR (virtual reality) team. In this interview, Wu describes her childhood, education, postdoctoral work at the University of California, San Diego, and work at Ricoh and Google, as well as her research on multimedia and tele-immersive systems.

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00:00:02

BA: Today is Friday, February 9, 2018 and I am Bethany Anderson from the University of Illinois Archives. I am speaking today with Wanmin Wu, alumna of the University of Illinois at Urbana-Champaign's Department of Computer Science, to talk with her about her experience as a graduate student in computer science and her work as a software engineer for tele-immersive systems. This interview is part of the ACM funded project "From Margin to Center: Reframing the History of Women in Computing and Information Technology through Oral Histories." So, first of all thank you for talking with me today Wanmin, I really appreciate it. So, I wonder if you could start talking about, a bit about your background and your childhood. First of all, where did you grow up?

00:00:45

WW: Sure. Thank you for interviewing me, Bethany. I grew up in Chengdu, a city in southwest China. It's best known as the hometown of giant panda bears and Sichuan cuisine. I grew up on a college campus. My grandfather used to be a professor there, although he passed away before I was born. My parents lived with me; they were very supportive of my education. And I was lucky to live in a community with the best schools in the city. So, I got to attend the best elementary school, middle school, and high school in my city. And I was very lucky to have met many great teachers there.

00:01:27

BA: Mm. Do you have any siblings?

00:01:29

WW: No, I was an only child but I had a very large extended family.

00:01:36

BA: Mm-hmm. So, growing up in this town were there any hobbies, or interests, or subjects at the schools that you attended that attracted your attention as a child and that might have led toward your decision to pursue a technical career later on?

00:01:52

WW: Yeah, I loved math from a very young age. At first, I found it interesting and found myself being good at it in elementary school. I remember one time my teacher gave the class a hard math problem to solve and I was the only one who came up with the correct solution.

00:02:10

BA: Mm.

00:02:11

WW: And later in middle school and high school I came to appreciate the beauty in math, especially in geometry. It was so much fun solving math problems. I had many other hobbies and interests, but I think my love in math at that time definitely helped drive my decision to pursue a career in computer science.

00:02:32

BA: Mm. When did you first become interested in computer science and computing as a field?

00:02:39

WW: I started taking programming lessons from very young in elementary school and then continued in high school. But, I think it was in college when I came to understand computing as a field more deeply. So, it was college.

00:02:54

BA: Mm-hmm. And when you were taking these programming and math classes did you have any particular math or science teachers in high school or before that who were supportive?

00:03:10

WW: Yeah. I remember my math teacher in high school was very supportive. He often gave us very challenging problems to solve to push our limits and he often asked me to lead some like class discussions on hard math problems.

00:03:26

BA: Mm-hmm.

00:03:27

WW: So that helped build my confidence and also grow my interest in math.

00:03:31

BA: Mm. Where did you attend university for your undergraduate degree?

00:03:38

WW: In Zhejiang University in China.

00:03:41

BA: And what did you decide to pick as your study or your major?

00:03:45

WW: I majored in computer science.

00:03:47

BA: And why did you pick that university as the place to pursue your education?

00:03:54

WW: There were two main reasons. First of all, Zhejiang University offered me admission without having to take the college entrance exam which was the biggest exam for all high school students in China. And also, the Zhejiang University also offered me the freedom to choose any major I liked with guarantee of admission, so that was very attractive to me. And second of all it's located in Hangzhou, a very, very beautiful city in China known as heaven on earth.

00:04:22

BA: Oh wow.

00:04:23

WW: So, it was a city depicted in numerous ancient poems in China.

00:04:29

BA: Mm-hmm.

00:04:30

WW: And I once visited the city with my mom and I just fell in love with it. I think it's a perfect place for college, so I went there.

00:04:39

BA: Wow. Yeah, that sounds like a nice place to be a student. So, speaking of which, what was it like to be a student at Zhejiang University? Did I pronounce that correctly?

00:04:52

WW: Yeah.

00:04:53

BA: Yeah. So, what was it like to be a student there?

00:04:55

WW: I loved the experience and I have so much fond memories there. We had a very large department. We had over I think 400 or 500 students in our grade, I don't remember the exact numbers but there were like thirteen classes. The female male ratio was about one to seven. We definitely had fewer girls than boys. And we used to live in eight-person dorms with like four bunk beds and barely any more left for a desk. And I was part of the English learning program where the computer science classes were all taught in English. We also used English textbooks. It was very challenging but definitely very rewarding.

00:05:40

BA: Mm-hmm.

00:05:43

WW: And our campus was located within walking distance to the West Lake and Lao Mountain in Hangzhou so it was very, very beautiful and I remember going there a lot on weekends, to read, to bike, and to hike, and to just hang out with friends. So, I had a lot of fun.

00:06:00

BA: Mm-hmm. So, did you take any science or math or computer science courses there that you found to be particularly memorable or instrumental to your career later on?

00:06:14

WW: Yeah. Because I majored in computer science, I took a lot of math and computer science courses there. I remember I had a lot of fun in a game development course where we developed many games, like greedy snake and balloon shooting. And another memorable one was the last course I took in the senior year before we graduate, we were given the freedom to work on any project that interested us. So, I chose to work on a project to screen 3D graphic hosting onto mobile phones.

00:06:46

BA: Mm-mm

00:06:48

WW: And that was like, ten years, more than ten years ago where we had very limited bandwidth and we had very primitive feature phones so I had a lot of fun solving the challenges. And the project actually ended up earning one of the highest scores in the department.

00:07:05

BA: Oh wow. That's really - that's amazing. So, did you also take any math courses that- I guess to rephrase that, did your interest in math at this time also continue on in parallel to your interest in computer science?

00:07:27

WW: Yes. Yeah. I remember the calculus courses were very challenging but very fun.

00:07:35

BA: Mm-hmm. So, when did you first come to the United States?

00:07:41

WW: I came in 2004.

00:07:42

BA: 2004. And you eventually went on to the University of Illinois where you pursued your graduate studies. Could you talk about that? The path that took you to the University of Illinois, how did you come to be a student here?

00:08:02

WW: Sure. So, when I first came to the US I was admitted to University of Central Florida and I studied there for about one and a half years. And because my husband got admitted to the University of Illinois Urbana Champaign, I applied to transfer there. It was not easy. At first, I was rejected by University of Illinois because it was such a prestigious university it holds a very high bar for admission into the graduate school. And I was very lucky because my then advisor, Dr. Kien Hua, in University of Central Florida, highly recommended me and he actually made a phone call to my advisor, later advisor, in the University of Illinois and saying I will be very successful in the school. And I was also very lucky that Klara Nahrstedt believed in me and offered me admission so I was able to attend University of Illinois for my grad school.

00:09:10

BA: So, your advisor from the University of Central Florida had reached out to Klara Nahrstedt and recommended you for admission into the program here. When you were first were admitted to the University of Illinois did you have a sense of what area of computing that you wanted to pursue and what role did Klara have in helping guide that educational path for you?

00:09:45

WW: Yeah. So, when I was in University of Central Florida, I specialized in multimedia with Dr. Kien Hua there.

00:09:55

BA: Mm-hmm.

00:09:56

WW: So, I had always been interested in multimedia systems and applications. And Klara is a well-known figure in this field. So, I basically, I just talked to her and learned about her recent project which is 3D tele-immersive system. Which was a very challenging but also a very advanced system which captured my interest. So, I basically studied the 3D tele-immersive system for my thesis.

00:10:32

BA: Mm-hmm. And what year did you come to the University of Illinois?

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WW: Around 2006.

00:10:38

BA: 2006. So, before you came to the University of Illinois it sounded like you were already beginning to explore multimedia. What was it about that topic that really drew you?

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WW: I think because multimedia is very visual - you can see what's going on. It's not like some research that's more like in the system where you don't see things. With multimedia, it's very visual and very interactive. So, you see the end results of the research and that's very engaging to me. For example, the 3D tele-immersive system, it's sort of like a 3D video conferencing system. So, you can experience the system there yourself and that's a very interactive and engaging process.

00:11:33

BA: Mm-hmm. Yeah. So, you just did a little bit of this but I was wondering if you could, you know, describe that area of research more for the layperson. So, what does it look to do research with tele-immersive systems?

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WW: Sure. So, it's sort of like 3D video conferencing. Basically, it connects remote people into a 3D virtual space so they can interact with each other. This system basically enables you to interact with a remote person as if you were together, face to face. For example, you could imagine dancing virtually with another person. You could do virtual light saber fight with another person. Of course, the system has to evolve. For example, later on we might have very advanced haptics system that allow you to feel the interaction. But also, with the visual and auditory feedback you will already feel like as if you were together with someone else.

00:12:40

BA: Hmm. So, is it, you know, and I'm not a computer scientist, but is it— Would it be sort of similar to virtual reality but not quite at that step yet but where you're kind of simulating, you know, a space that allows someone to interact and looks more or less real? Is that a fair assessment or am I off the mark? [laugh]

00:13:07

WW: Yeah. It's very fair. It's very closely related to virtual reality, where you're immersed into virtual space.

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BA: Mm-hmm. Mm-hmm.

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WW: And here with 3D tele-immersive systems, you're immersed into a virtual space with someone else. So, it's more focusing on interpersonal interaction and communication.

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BA: Okay. Well, thanks for clarifying that. Getting back to your time as a student at the University of Illinois, could you talk about what it was like to be a student at Illinois and how did that compare to your time as a student at Jiujiang University?

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WW: Oh. So, it was beyond my wildest dream that I could have the chance to study at University of Illinois because it was such a prestigious university with a very high rank graduate program. So, I had, I think, the most wonderful experience there as a grad student. I got to take courses with some of the most well-known professors in their fields and I got to work with excellent people on course projects. I learned a lot from just my peers. And I got to access some of the most advanced technologies and systems in our field, like 3D tele-immersive systems. At that time, not many universities could afford building such a high-tech system. And I got to learn how to do research from my advisor, Klara Nahrstedt, and also senior lab mates in my lab and I just felt very fortunate to have the chance to study there.

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BA: Mm-hmm.

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WW: Compared to Zhejiang University, I think the program in University of Illinois is definitely like more organized and more advanced in terms of like, because it involves a lot of research in the grad program. At Zhejiang University, for me, because I was an undergrad student, I was mostly focusing on taking courses and finishing course projects. But at Illinois, it was more exploratory research into some of the state of the art algorithms in the field and also, systems in the field.

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BA: Mm-hmm. What were some of the specific research projects that you worked on as a student here?

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WW: So, in tele-immersive systems, I worked on several projects. For example, one of them was "How do we reduce the amount of data that's being processed and streamed in tele-immersive systems?"

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BA: Mm-hmm.

00:15:57

WW: So that the system and network can actually catch up to provide a better user experience. So, in that project we found out actually a lot of the data that's in the system are actually redundant perceptually to human eyes. So, we are processing, we're capturing, and also streaming all this data but at the end of the day the user actually could not tell a difference if we just removed those data. The project basically focuses on using a psychophysical approach to determine which data are redundant to human eyes and actually remove them in real time so we can provide better user experience because there's less data to process so the system can be faster. And it can render better with the limited time, so yeah.

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BA: Okay. Thank you. So, when you were a student here, were there any student groups or organizations that you became involved in?

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WW: I was involved in Women at CS.

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BA: And what did you do as part of that group?

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WW: I was not part of the organization but more of a participant. I attended talks, seminars, and I—It was very interesting to get to know other women peers in the department.

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BA: Mm-hmm. And what kinds of seminars and talks did the Women in CS program organize?

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WW: I remember some of them were just like forum discussions with women students where we shared our thoughts and experiences as a female student in this department.

00:17:49

BA: So, speaking of women in computer science. You know, historically the number of women students in the College of Engineering has gradually increased over time. So, for example, of its 234 entering students in 2014 only 62 of those were women, and that's for the Department of Computer Science. So, what are your thoughts about this increase but that, nonetheless, fewer women students in this area and are there any challenges you believe women students face or have faced or not?

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WW: Yeah. I think the faculty in this school have been doing a great job making the department more diverse.

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BA: Mm-hmm.

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WW: In a lot of aspects, but also in terms of gender. I remember when I was in the program, there were very few women students and in some of the classes I was the only girl. It was challenging. I think stereotypes play a large role. Basically, a lot of media depicted programmers as nerdy boys who basically started programming like from eight years old and many girls will feel distanced by such images depicted by the media. And they may feel they don't belong in this field, so they basically never thought of pursuing a career in it. I think there are many unique challenges women students will face in computer science. Being a minority itself is a lot of challenges. For example, we have less role models. A lot of professors are men and also our senior peers, most of them are men. And there's also research showing women are more prone to imposter syndrome than men. Yeah, so these are some of the challenges I think women face.

00:20:00

BA: Mm-hmm. So, you mentioned that in some of your classes you were the only woman at times and there were fewer women students than male students. And also in the faculty you mentioned there are, were fewer women faculty to look up to as role

models and to work with. So, I wondered if you could talk a bit about Klara Nahrstedt, who was your advisor, and what that relationship was like in particular, to have a woman faculty as an advisor in this area?

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WW: Yeah. So, Klara Nahrstedt gave me tremendous support in my graduate studies. She was that type of professor who put students at first. Always.

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BA: Mm-hmm.

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WW: I can't remember how many days and nights she just spent revising my paper, my drafts, over and over again and being a woman advisor, she served as a great role model for us, allowing me to see how much a woman can achieve in this men-dominated field. And Klara achieved so much and she's so kind and so supportive and I just feel very confident, and also fortunate, to pursue a career in computer science because of her. Yeah.

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BA: Yeah. So, when you were here at Illinois were there any other colleagues, friends, or faculty who were particularly influential on you and your work?

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WW: Yeah, there were many. So, many of my senior lab mates helped me a lot in developing research skills, publishing papers. And there were also faculty members in some of the courses who gave me a lot of support and also allowed me to build a lot of confidence in the department. For example, I remember Lui Sha, Professor Lui Sha had a course with me and I was basically doing projects. I was trying to do my best to do some of the projects and he really liked what I did. I was one of the very few female students in his class. And he actually pulled me aside just to tell me how great my work was and that was very memorable and thanks to all this support given by these great professors and also senior colleagues I think I was able to finish my thesis study successfully.

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BA: Mm-hmm. Yeah, that's great. So, speaking of which, if we could talk about your dissertation.

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WW: Yeah.

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BA: And hopefully I get the title here correct. Your dissertation was titled "Humancentric Control of Video-functions and Underlying Resources in 3D Tele-immersive Systems." So, could you talk about your dissertation and why you decided to pursue that particular topic?

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WW: Sure. So, 3D tele-immersive systems are generally very challenging. A big reason is because it has to deal with a lot of data in real time. So, that required a lot of computing and networking resources. And because sometimes the network and the system cannot catch up to so much data, user experience will degrade. For example, you will see very slow frame rate in the system. So, you see the person becoming slower. Moving slower and slower. And also, there could be like holes in the captured data which will look artifacts so all these basically caused bad user experience.

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BA: Mm-hmm.

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WW: My thesis was focusing on finding ways to improve the user experience by reducing the data amount the system and the network has to process.

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BA: Mm-hmm.

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WW: Historically, there were a lot of techniques that were system centric. So, the

problem is all these techniques improve upon system centric metrics and those metrics don't necessarily reflect the end user experience metrics so there's a gap there. Basically, not all improvements are equal. I was more interested in the human side. I was looking at metrics that can actually measure the user experience in the end and then we use that to devise techniques to improve upon those metrics. So, for example, I designed a framework to measure the quality of experience of users and then later on developed a technique to improve the system on those metrics. And that improved the user experience more effectively than the traditional system centric techniques.

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BA: So, for this dissertation you actually won an award for it, the ACM SIGMM. I'm not sure if there is an abbreviation or way to pronounce that abbreviation, but you won this award for Outstanding PhD Thesis in Multimedia Computing Communications and Applications in 2012. So, could you talk about winning that award and what did it mean to you?

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WW: Yeah. It was a huge honor to be recognized by this award. I think part of the reason was my research looked at the problem in a new way. As I said, traditionally researchers mostly focused on system-centric way and I changed course to look at the problem in a human-centric way. And that turned out to be more effective. And I mean, this was beyond my imagination that I could win this award. I remember in college I would look up some of the ACM Multimedia publications and I would never think that someday I could publish there but eventually I got to publish in the best conference, in ACM SIGMM, which is ACM Multimedia and my research actually won the best paper award there.

00:27:02

BA: Mm-hmm.

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WW: And later on, combined some of the work, my thesis won this thesis award. Yeah. So, it was very honoring to me.

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BA: Wow. Yeah. Well, congratulations on that award even though it was a couple of years ago at this point!

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WW: Thank you.

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BA: So, you graduated then in 2012, is that correct?

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WW: Yeah. 20- yeah.

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BA: So, did you – After you graduated with your- and received your PhD, did you pursue a post-doctoral position anywhere? And if so, where did you end up going?

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WW: Yeah. I was a post-doc at University of California at San Diego.

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BA: And what was the nature of your research at UC San Diego?

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WW: There I worked with doctors because they had a very good medical school. I worked with doctors to develop technology that helps users become more healthy. So there, I learned about mobile sensors, I learned about machine learning. Yeah. It was a very interesting project.

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BA: Mm-hmm. And how long were you there for?

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WW: About a year.

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BA: And after UC San Diego where did you go next?

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WW: I moved to the Bay Area.

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BA: Did you move to the Bay Area to pursue a position at a company? Or what was the nature of your – the reason for moving there, rather?

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WW: Yes. So, I accepted a position at Ricoh Innovation which is a small R&D lab in Menlo Park.

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BA: Mm-hmm. Okay. And what was your position at Ricoh?

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WW: At first it was research scientist.

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BA: And what was the nature of your work as a research scientist there? What kind of projects were you working on?

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WW: So, we did research in light field displays. As you know, almost all augmented reality, virtual reality displays nowadays have this intrinsic problem of making people sick after some time of use.

00:29:11

BA: Mm. Mm-hmm.

00:29:13

WW: This was because those displays created what's called accommodation convergence conflict in our eyes, which is a mismatch between our focus and convergence cues in our eyes when viewing some of the content there. So, light field displays were developed to solve this problem. We were building a light field display prototype and also capturing light field data from a light field camera and then displaying it to human eyes and it looked much, much better.

00:29:45

BA: And how long did you work on that particular project for?

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WW: It was almost two years.

00:29:54

BA: And then did you move into a different position at Ricoh or did you move elsewhere?

00:30:01

WW: So, after Ricoh I joined YouTube.

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BA: Okay. And where was this YouTube location located?

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WW: The headquarters of YouTube is in San Bruno, California.

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BA: Okay. And what year was this?

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WW: It was 2016, I think.

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BA: 2016. So, you are at Ricoh then from roughly 2013 to 2016 for a total of three years?

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WW: Yeah.

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BA: Okay.

00:30:33

WW: Yeah.

00:30:34

BA: And what was your position at YouTube?

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WW: Software engineer.

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BA: And what kinds of projects were you working on at YouTube?

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WW: I worked on, right now I'm working on YouTube VR, virtual reality.

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BA: Okay. And what is the nature of that particular project? What are you exploring with regards to virtual reality?

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WW: So, we are developing YouTube VR to host VR videos on our platforms, basically making it the best platform for VR videos in the world. Yeah.

00:31:18

BA: Oh. Well, that sounds like a really impressive endeavor!

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WW: Thank you.

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BA: So, just to back up for just a quick second here. In respect to your current position at YouTube, were there many women who worked at Ricoh and also, how many women work in your area at YouTube? What does that look like?

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WW: Yeah. So, Ricoh was a very small research lab.

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BA: Mm-hmm.

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WW: But we had many women researchers, fortunately, at Ricoh. I got to work with two other women colleagues very, very closely. YouTube is much larger than that. We definitely have a lot of women colleagues here. But I would say the ratio is definitely lower than what we had in Ricoh.

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BA: Mm. Why do you think that is?

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WW: I think part of the reason was because of the size at Ricoh. And we happened to recruit a lot of good female researchers. At YouTube it's harder. Definitely harder,

because given the scale, it's just very hard to recruit a lot of women engineers in the field.

00:32:41

BA: Mm-hmm.

00:32:42

WW: I think the last report from Google was about 30% of the company are women employees. And in tech I guess it could be roughly the same or lower.

00:32:57

BA: Mm-hmm. Okay. And so, you've been at YouTube since 2016 and now you, but you work more largely for Google, is that correct?

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WW: So, YouTube is part of-

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BA: Right.

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WW: The family.

00:33:15

BA: Right, right. Yeah. So, did you move around at all in Google or are you still just with the YouTube team?

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WW: I've always been YouTube.

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BA: Oh. Okay. Sorry, my apologies.

00:33:24

WW: Oh, no.

00:33:26

BA: So, in your position there at YouTube have there been any opportunities for advancement in your current position or were there opportunities for advancement in your previous positions?

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WW: Yeah. So, for example at Ricoh I was promoted a year, about a year after joining which was among the fastest in the company.

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BA: Mm-hmm.

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WW: Partly because I had amazing colleagues to collaborate with and also partly because my manager at that time was very supportive and recognized my work. Here, I'm also on the path of advancement. I've been asked to mentor junior engineers. Yeah.

00:34:13

BA: Mm. So, speaking of mentorship, could you talk a little bit about mentors that you've had over the course of your career spanning from your time as a student to the present? You know, what kind of mentors have you had and what is your approach to being also a mentor, yourself?

00:34:35

WW: Yeah, so back in Illinois I think the culture in our lab was senior lab mates or senior students will help mentor junior students and I was part of this culture. So, when I first entered the university I got mentored by senior colleagues who were very helpful and very supportive, so I sort of learned this mentoring technique, skills, and also the culture from them. And as soon as there are junior students entering the lab, we will mentor them. And in the company, it was very similar. So, after I became familiar with the work I would mentor junior colleagues and help them ramp up on projects and also help them sort of adjust to the company and the culture.

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WW [cont.]: In my approach, I think there is, I am very interested in helping people grow. That's how I would want to be mentored by other people so I basically do exactly what I would want for mentoring. Yeah.

00:35:55

BA: Alright. So, to talk a bit about another role that you have here for a minute. So, are you currently associate editor for the ACM Multimedia Journal, is that correct?

00:36:09

WW: I actually just resigned in December.

00:36:14

BA: Okay.

00:36:15

WW: After four years of work.

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BA: Okay. So, could you talk about that experience being an editor and what did you like about editorial work?

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WW: Yeah, so my main responsibility there was to handle the review process for submitted papers in my area from end to end. Basically, this involves screening the paper initially and then inviting reviewers to provide opinions on the paper and finally, make a decision - acceptance or rejection of the paper. And what I like about the work is I was able to make this contribution to give back to the research community because I've been involved in the research community for a lot of my past work like my publications, attending conferences. I think this was a great opportunity for me to give back. Yeah.

00:37:14

BA: Mm-hmm. Mm-hmm. So, beside this editorial work that you've done for the ACM Multimedia Journal, have you been involved in any professional organizations and if so, in what capacity?

00:37:27

WW: Yeah, so I've been involved a lot in the SIGMM community and also, ACM, IEEE. I've been an active reviewer for many conferences and journals. I also helped some of the organization for the conferences. For example, I've been track chair and a workshop chair for the past ACM Multimedia Conferences.

00:38:00

BA: Okay. Well, one question that I try to ask all of the interviewees for this project is the following: So, if you could describe your research process to an anthropologist, for example, how would you describe it? What are the materials, the software, the hardware that you use and interact with on a daily basis? And how would you describe that to someone?

00:38:27

WW: Sure. So, I'll take the example from my graduate program which is the tele-immersive system.

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BA: Mm-hmm.

00:38:36

WW: We built. I think we always started with finding a problem to solve. This is probably the most important part of the whole research process in computer science. First of all, you have to find an interesting problem and the problem ideally has to be real, trackable, challenging, and also if you solve the problem, it has to be impactful. Once you narrow it down to a problem you review literature to see what's been done here and then you start to design new techniques to solve the problem. Sometimes, this process can be exploratory. For example, you can start with something but then later on you find another more related and more interesting problem, more challenging problem during the investigation. But basically, after you finalize on the problem, you design solutions, you implement the solutions, and then do experiments.

00:39:42

WW [cont.]: Sometimes, this involves real users. And then you collect experiment data, analyze them, and then publish them. So, that's an end to end process of research in computer science and in terms of materials, software, hardware we use. So, tele-immersive systems we had this large system where we had array of 3D cameras to capture the scene and a bunch of computers to process the data, compress the data, stream the data onto internet to another remote location and also the computers will receive data from the remote location and then render them on a large display. So, overall the system consists of cameras, computers, and also large displays.

00:40:38

BA: Mm-hmm.

00:40:39

WW: And we also do calibration of the cameras so we use cardboard with grids on them to calibrate the camera. Basically, to figure out where the cameras are in the space so later on we can render the data correctly at the remote location. And software, it's basically programs running on the computers to get the data from cameras, reconstruct a 3D model of it and then compress it and then stream it and also render it. So, it's a very complicated system.

00:41:20

BA: What are some of the software programs that you use?

00:41:30

WW: We used, for example, MATLAB to calibrate the camera.

00:41:33

BA: Okay. Mm-hmm.

00:41:35

WW: We wrote our own code to process the data, compress the data, and then stream them. So, it was, for example, in C++, the code to do all this kind of processing. And then used OpenGL to render the data.

00:41:54

BA: Okay. So, speaking of programming and coding. Are there any particular programming languages that you like the best or – Yeah. What are your thoughts about that?

00:42:09

WW: I like C++ because of its efficiency and so for example, in tele-immersion we use a lot of C++. Nowadays, at YouTube, in virtual reality app, we write Java because it runs on Android systems. Java is not the most efficient language but it's, I mean, self-explanatory because it's very verbose and so if you look at Java code, it's very easy to understand.

00:42:47

BA: Mm-hmm.

00:42:48

WW: And also, less easy to make mistakes. [laugh]

00:42:52

BA: [laugh] Alright. Okay, so, I'm going to ask you a rather broad question here. So, what is the ultimate or fundamental problem that you are trying to solve with your research on tele-immersive systems? If you're thinking more largely, about humanity and how we interact with one another and interact through these systems, perhaps, what is it you want to consume or you know, get from interacting with this media?

00:43:30

WW: Yeah. So, fundamental problem I think I hope to solve is to diminish the geographical barrier between people as much as possible so someday it might not be necessary to travel if you want to hang out with someone. That way we can save a lot of air travels and reduce carbon emissions in the world. It- Yeah, so it's an ultimate dream to, for example, implement something that's being depicted in Star Wars where if you want to interact with someone the 3D holograms of that person just appear in front of you and you can do all sorts of communication, interaction with that person without having to travel.

00:44:26

WW [cont.]: And in terms of media consumption, my dream has always been 3D data. For example, if you think about TVs we have nowadays it's 2D. It's basically flat and it's very limited. What I had in mind was two approaches. One is you wear near eye displays. You put on these displays and the thing that you want to see is just in 3D, just looks so natural. It looks so real in front of your eyes and it could a very large field of view so it's way larger than today's TVs and it will feel very immersive.

00:45:13

BA: Mm-hmm.

00:45:5

WW: And the other approach is like a 3D display where you, sort of like a holographic display, where you don't have to wear glasses but you see this projection of realistic 3D data. So, for example if you want to see a football game, like an NFL final game. It will just look in 3D in this box and you can see every aspect of it. You can see from any viewpoint.

00:45:49

BA: Mm.

00:46:50

WW: And the person, the players on the field, just look real in this 3D projection. It's not 2D anymore. That's a dream. Someday. [laugh]

00:46:01

BA: [laugh]

00:46:03

WW: Hopefully, we see that.

00:46:04

BA: How far away do you think we might get from that sort of virtual reality, as it were?

00:46:11

WW: I think the near-eye one, the first approach, much sooner.

00:46:14

BA: Mm-hmm.

00:46:15

WW: But the latter one, the holographic one, will be probably later. But the near eye one, as you see, we already have so much progress in the past few years about near – about virtual reality, augmented reality and near eye displays.

00:46:31

BA: Mm-hmm.

00:46:33

WW: Yeah.

00:46:34

BA: Well, so we'll stay tuned for that to come around. So, thinking about your career so far, are there specific events in your career that you consider to be the most rewarding?

00:46:52

WW: I think it's the fact that my PhD advisor, Klara Nahrstedt, offered me admission to University of Illinois, because that was the best thing I think that happened in my career. That not only allowed me to be with my husband [laugh] but it also gave me the opportunity to receive the best graduate education.

00:47:18

BA: Mm-hmm. Have there been any major setbacks in your career that you would be willing to discuss?

00:47:26

WW: None that I can think of. I think I've achieved more than I've imagined ever before. So, everything felt like I—I mean everything felt like, beyond my dream. [laugh]

00:47:48

BA: [laugh] Yeah. So, in reflecting on your experience as a software engineer so far, from your perspective are there ways in which being a woman in computing and information technology has changed since you first entered the profession?

00:48:03

WW: Yeah. So, I do see a lot more emphasis in diversity nowadays now than the past. I feel really happy that nowadays more and more companies and schools put diversity as one of their top goals now. For example, Google and also for example, Illinois, when I talked to my advisor, Klara Nahrstedt, last year she was telling me how much the university has been doing to have more women students enrolled in the computer science program so I feel like it's really great that these companies and organizations are spending a lot of effort and resources to increase diversity on the campus and in the workplace and I feel very fortunate to be part of this.

00:48:56

BA: Mm-hmm. Thinking the future, what do you want the future to look like for women in computing, if you could just speculate broadly?

00:49:08

WW: I hope someday that we don't have to talk about this anymore, because it will feel natural. The workplace is just mixed with equal ratios of men and women and this diversity thing is happening naturally someday and I mean, that's a dream.

00:49:30

BA: Mm-hmm. Mm-hmm. Yeah. Something that we can definitely hope for hopefully in the near future for sure. So those were the only questions I had for you Wanmin. Are there any other questions or topics that I might have asked you about?

00:49:47

WW: No.

00:49:48

BA: Okay.

00:49:49

WW: Thank you for interviewing me. I— It was great talking to you.

00:49:53

BA: Yeah, great! Thank you so much for your time and for talking to me about your career and your experience as a student at the University of Illinois and in China and yeah, really appreciate you sharing your story with us.

00:50:08

WW: Thank you. Thank you for your time.

00:50:10

BA: Thank you. Take care! Bye!

00:50:12

WW: Bye!

End of interview