

## In Brief

An estimated 360 million people worldwide suffer from hearing loss<sup>1</sup>, including approximately one-third of all people over the age of 65. For people with profound hearing loss, the primary form of communication is sign language. Sign language has been in existence in different forms for more than 500 years and is like any other language with dialects and linguistic elements.

There are many methods for translating sign language and aiding communication between the signer and non-signer. The most common are a sign language interpreter, voice-to-text transcription, and, of course, pen and paper—but each of these has pros and cons in terms of cost, availability, or convenience. Sign language recognition has been explored in recent years by using multiple input sensors, and now, researchers at the Chinese Academy of Sciences and Beijing Union University have teamed up with Microsoft Research Asia to research such a system. Microsoft Kinect technology was used to create a cost-effective and capable technology prototype that enables sign-language communication between signer and non-signer, and offers translation between different sign languages.

## Xilin Chen

Deputy Director  
Institute of Computing Technology  
Chinese Academy of Sciences

## Hanjing Li

Professor  
Beijing Union University

## Tim Pan

Director of Microsoft Research  
Connections  
Microsoft Research Asia

## Stewart Tansley

Director  
Microsoft Research Connections

## Ming Zhou

Principal Researcher  
Microsoft Research Asia

## Websites:

[english.cas.cn](http://english.cas.cn)

[microsoft.com/en-us/kinectforwindows](http://microsoft.com/en-us/kinectforwindows)

[research.microsoft.com/en-us/labs/asia](http://research.microsoft.com/en-us/labs/asia)

[english.buu.edu.cn](http://english.buu.edu.cn)

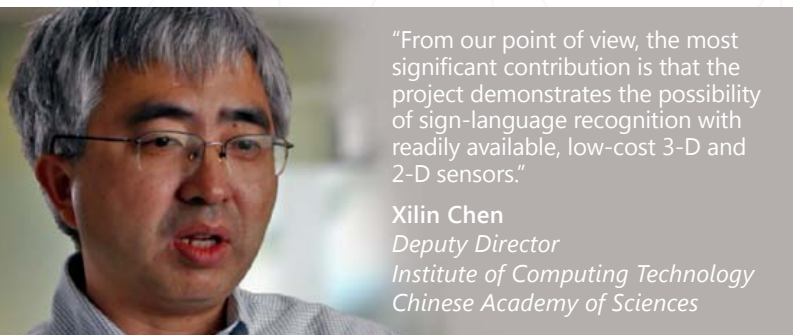
[research.microsoft.com/nui](http://research.microsoft.com/nui)

# Kinect Sign Language Translator expands communication possibilities

*Sign language is a language like other languages, with dialects and linguistic elements, but based on gestures rather than spoken words. Although other communication methods exist and the number of people who use sign language continues to grow, communication between people who can and cannot hear can be challenging. The gesture recognition of Microsoft Kinect technology now makes it possible to develop a more natural and cost-effective way for signers to converse with non-signers.*



Dedicated researchers in China have created the Kinect Sign Language Translator, a prototype system that understands the gestures of sign language and converts them to spoken and written language—and vice versa. The system thus can capture a conversation from both sides. For example, the signer is shown signing, with a written and spoken translation being rendered in real-time for the hearing person. The non-signer is represented by an avatar that takes his or her spoken words and turns them into accurate, understandable signs to accompany the written translation for the deaf person to “read,” all in real-time. It’s an amazing prototype that has been met with enthusiasm everywhere it’s been shown. It’s not only a fascinating piece of technological wizardry; it’s a potential game-changer for many in the signing and non-signing communities alike.



“From our point of view, the most significant contribution is that the project demonstrates the possibility of sign-language recognition with readily available, low-cost 3-D and 2-D sensors.”

## Xilin Chen

Deputy Director  
Institute of Computing Technology  
Chinese Academy of Sciences



*Dandan Yin, a highly proficient signer from Beijing Union University, helped evaluate the system's ability to read gestures and correctly translate them into spoken and written Mandarin.*

## ASIA ANSWERS THE CALL

East Asia is home to more than 79 million people<sup>2</sup> with severe hearing loss. So it's no wonder that Chinese researchers have led the way in developing a prototype system that enables both sign language translation and a learning environment for sign language that gives real-time feedback. This was a result of collaboration, facilitated by Microsoft Research Connections, among the Chinese Academy of Sciences, Beijing Union University, and Microsoft Research Asia (based in Beijing), each of which made crucial contributions to the project.



"We had all heard of the potential for Kinect to recognize the gestures of sign language for people who are deaf. Some people had even prototyped demonstrators. But we were not aware of a concerted effort from a professional research team. This was the difference in China."

**Stewart Tansley**  
Director  
Microsoft Research Connections

Professor Xilin Chen, deputy director of the Institute of Computing Technology at the Chinese Academy of Sciences, has spent much of the past decade studying sign language recognition, hoping to devise a way to enable signed communication between people with hearing loss and their hearing neighbors. Like all sign languages, Chinese Sign Language involves complex hand movements and positions. People who learn sign language as children become amazingly adept at "speaking" by signing, as anyone who has seen the flying hands of fluent signers conversing can attest.

Professor Chen set an objective: to develop a technology that would enable non-signers to understand signed Chinese without actually having to learn the language—and give them tools to help them learn the language. And he knew that

advanced sensor and software technology was the likely solution.

"We knew that information technology, especially computer technology, has grown up very fast. So from my point of view, I thought this is the right time to develop some technology to help [people who are deaf]. That's the motivation," Chen explained.

## ENTER MICROSOFT KINECT

Motivation met action when Kinect for Xbox came on the scene. Originally developed for gaming, the Kinect device's special sensors read a user's body position and movements and, with the help of a computer, translate them into commands. This is wonderful if you're a gamer engaged in a virtual tennis match or in a role-playing fantasy fighting aliens. It also has tremendous potential for understanding the complex gestures that make up sign language and translating the signs into spoken or written words and sentences.

"From our point of view," says Chen, "the most significant contribution is that the project demonstrates the possibility of sign-language recognition with readily available, low-cost 3-D and 2-D sensors."

As Stewart Tansley of Microsoft Research Connections observes, the November 2010 release of Kinect generated tremendous interest in the research community worldwide. Then the June 2011 release of the Microsoft supported Kinect for Windows software development kit (SDK) helped make the technology broadly available for scientific use. Microsoft Research Connections was eager to encourage the most promising uses of Kinect, but with so much fervor over Kinect in the research world, it was hard to select which projects to support.

So, Tansley turned to Microsoft Research's worldwide labs, asking them to submit the best Kinect academic collaborations they had under consideration. At Microsoft Research Asia, Principal Researcher Ming Zhou, who was heavily involved in natural language models and translation and had forged a tight collaboration with the Chinese Academy of Sciences, convinced the lab's management to submit his work with Chen on the sign language translator.

Tansley was impressed by the Chinese proposal. "We had all heard of the potential for Kinect to recognize the gestures of sign language for people who are deaf. Some people had even prototyped demonstrators. But we were not aware of a concerted effort from a professional research team. This was the difference in China."

It was a potent arrangement indeed. Complementing Chen's group at the Chinese Academy of Sciences were Zhou and other senior researchers from Microsoft Research Asia, where a great deal of automated translation work was already underway. Microsoft Research Asia computer scientists were working on real-time machine translations of English



*By using the Kinect Sign Language Translator, signers could communicate independently with a non-signer without an interpreter.*



*The Kinect Sign Language Translator translates the gestures of sign language to spoken and written language—and vice versa.*

to Mandarin, as former head of Microsoft Research Rick Rashid prominently demoed in a video that became a YouTube sensation in October 2012.

Speaking about the collaboration with Microsoft Research Asia, Chen noted that "...the main benefit is that they can give us more support on the Kinect technology itself, because Kinect is from Microsoft. And they have experts in machine translation, and our project is also a kind of language translation, going from sign language to spoken language. So they give us a lot of support."

Tim Pan, director of Microsoft Research Connections in Asia, likewise praises the collegial and complementary spirit of the Kinect Sign Language project. "If I can pick a key word for this project, that would be collaboration, because this project wouldn't be possible without experts in the sign language, experts in integration of the whole system, and also, from the Microsoft

"If I can pick a key word for this project, that would be collaboration, because this project wouldn't be possible without experts in the sign language, experts in integration of the whole system, and also, from the Microsoft Research side, some key technologies."

Tim Pan

Director of Microsoft Research Connections  
Microsoft Research Asia

Research side, some key technologies."

#### TESTING THE SYSTEM

And as Zhou is quick to note, the collaboration extends to the special education program at Beijing Union University. "One unique



*The Chinese Academy of Sciences, Beijing Union University, and Microsoft Research Asia collaborated to develop and test the Kinect Sign Language Translator prototype.*



graceful signer, Yin told the research team that working on this project was the fulfillment of her childhood dream “to create a machine for people with hearing impairments.”

Watching Yin sign back and forth with an avatar, you can see the potential future of communication between people who are deaf and those who can hear. And while all the collaborators are quick to stress that the Kinect Sign Language Translator is a prototype, not a finished product, all are equally vocal in expressing their belief that it has the potential to provide a cost-effective and efficient means of communication between those who are fluent in sign language and those whose signing is limited to crude gestures.



contribution of this project is that it is a joint effort between software researchers and the students who are deaf,” he says. “A group of teachers and students from Beijing Union University joined this project, and this enabled testing of our algorithms to be conducted on real-world data.”

Professor Hanjing Li of Beijing Union University works in the university’s special education school, where she specializes in the education of students with deafness. It was in her lab that the Kinect prototype was put to the test, as highly proficient signers evaluated the system’s ability to read their gestures and correctly translate them into spoken and written Mandarin. Naturally, they also tested the reverse process as well, making sure that the non-signing person’s avatar was correctly forming the signs for the spoken input.

As someone who has devoted her professional life to improving education for students with hearing loss, Li is extremely enthusiastic about the Kinect Sign Language Translator, seeing its promise as extending far beyond education. “This project has enormous potential—since daily communication presents a huge challenge for the millions of Chinese people who have hearing impairments,” she said.

#### A PROMISING FUTURE

Among Li’s testers was Dandan Yin, a dynamic, accomplished young computer scientist who has deafness. An especially proficient and



Tansley conjures up the scenario of a person with deafness visiting a physician who doesn’t know sign language. While acknowledging that the patient could pre-schedule an interpreter or resort to communicating with paper and pen, he observes that such interactions “...would be very artificial. But with this technology, they could simply use their natural sign language.” Thus, a signer would be empowered to communicate independently with a non-signer without scheduling an interpreter or resorting to other methods.

Tansley relays that the system could even open up more job opportunities for people who are deaf. “Imagine an information kiosk, say, at an airport, and rather than the person seeking information being deaf, imagine that the person staffing the information kiosk was deaf. Now, a non-signer could come to that kiosk and ask questions and could use the system to help them communicate.”

Those scenarios don’t seem too far off, thanks to the dedicated researchers and partners who are working to make the Kinect Sign Language Translator a reality—and, in the process, fulfilling the childhood dream of Dandan Yin and millions of other people in China and around the world who are deaf or hard-of-hearing.

<sup>1</sup> World Health Organization, February 2013. Disabling hearing loss refers to hearing loss greater than 40 dB in the better hearing ear in adults and a hearing loss greater than 30 dB in the better hearing ear in children. ([www.who.int/mediacentre/factsheets/fs300/en/](http://www.who.int/mediacentre/factsheets/fs300/en/))

<sup>2</sup> Global estimates on prevalence of hearing loss. ([www.who.int/pbd/deafness/WHO\\_GE\\_HL.pdf](http://www.who.int/pbd/deafness/WHO_GE_HL.pdf))