



**IBC2023**

## **SIGN LANGUAGE INTERPRETER**

## **VIRTUAL HUMAN AVATAR "KIKI"**

Toru Namba

NHK Enterprises, Inc. Japan

### **ABSTRACT**

NHK Enterprises, Inc. has produced an avatar, KIKI, that looks like a real person. The texture of each facial part, the texture of the hair, and the fine texture of the skin are so realistic that one can almost feel the body temperature of her.

KIKI has debuted in 2023 to deliver information in Japanese Sign Language for making an Inclusive Society.



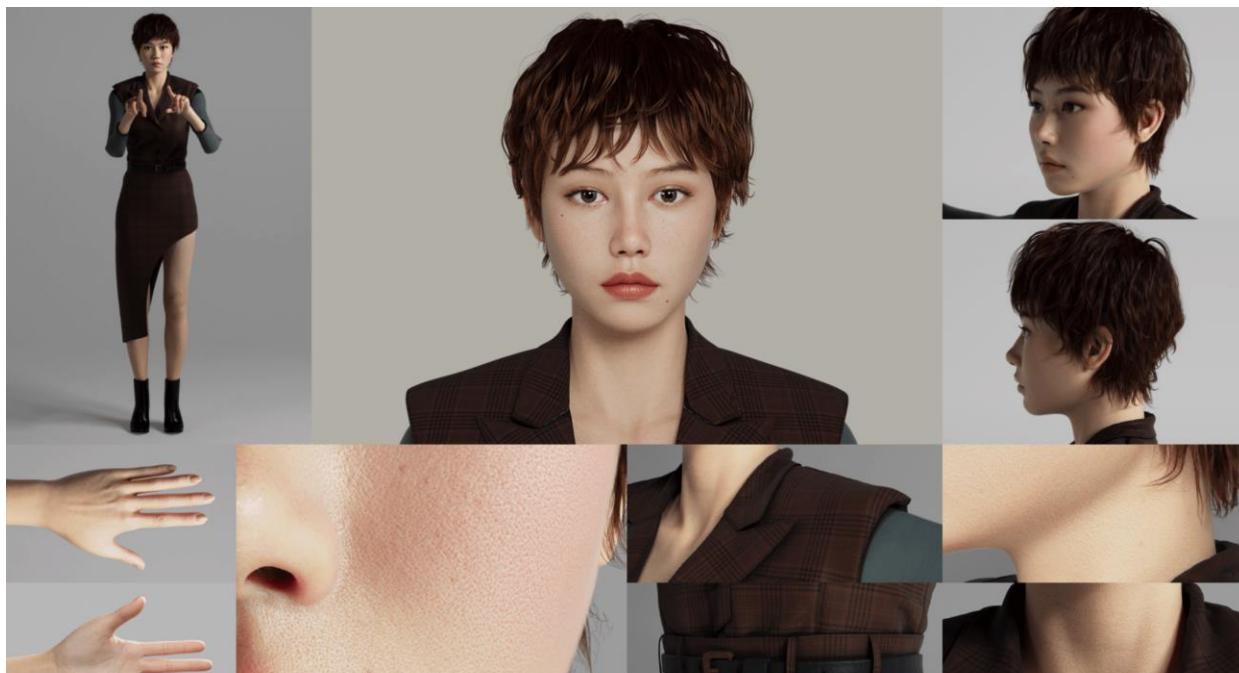
### **INTRODUCTION**

Why did we produce such a virtual human? In sign language, not only the movements of hands and arms, but also the movements of face, mouth, and body are the important elements of expression. It is also a language that communicates by using a wide range of space around the body, front, back, left, and right. Therefore, to accurately convey information, the avatar needs to be designed in a realistic 3D design.



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## THE BIRTH OF "KIKI," A VIRTUAL HUMAN



KIKI, a virtual human, is not one of those avatars that had released before. She was designed in 2D using MAYA software, which is used widely in 3DCG production. The 3D model was then created using Unity, a popular game engine. In order to give the virtual human a realistic appearance, we have paid close attention to the details of its appearance. For example, the freckles on the face, moles, and ear piercings in the ears are incorporated into the design, and the colour difference between her palm and back, which is important for sign language expression, has been carefully expressed.

In addition, the 3D design reproduces the range of motion that forms facial expressions to express rich emotions of joy, anger, sadness, and humour. The lighting and shading of the virtual human have been also put to increase the sense of reality.

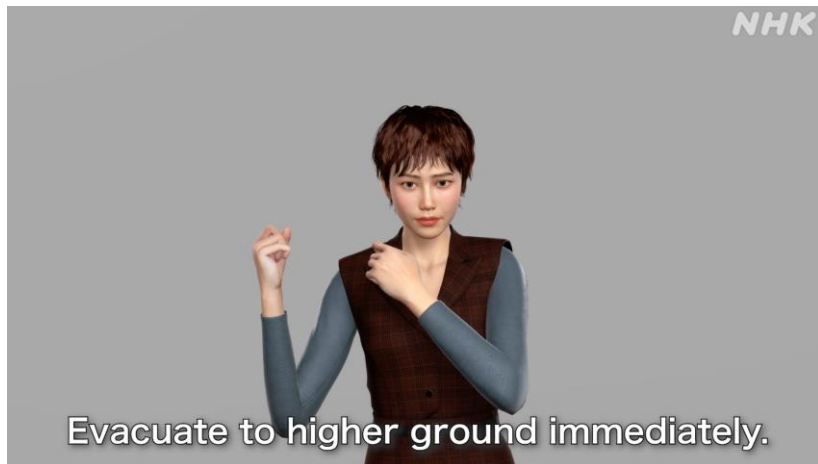
But why were we hung up on such realism? It is simply because sign language is a language expressed by using three-dimensional space and is also a visual language in which the sensitive movements of face convey messages more accurately with hand movements, which is why we have produced a more realistic avatar that no one has ever seen before.



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## SIGN LANGUAGE CG SERVICE AT NHK (LAUNCHED IN 2022)

For NHK and its group including NHK Enterprises, it is inevitable to deliver life threatening information to everyone since public welfare is one of the most important roles of NHK as a public broadcaster. In Japan, where natural disasters such as heavy rains and earthquakes are inseparable from daily life, the NHK Group as public media is united in



its efforts to report “disaster prevention and mitigation”. This is why we have been developing a Sign Language CG Service to provide information on disasters to as many people as possible, including those who are deaf and hearing-impaired people.

“The Weather Disaster Prevention Sign Language CG Service” launched on NHK's website last October provides real-time information on disasters such as earthquakes and Tsunami and has become an indispensable information tool for deaf people. While disseminating disaster information, the service also provides nationwide weather information daily when no disasters are occurring. Regional settings are also implemented so that users can access the weather information of the area where they live in as soon as they access the site.

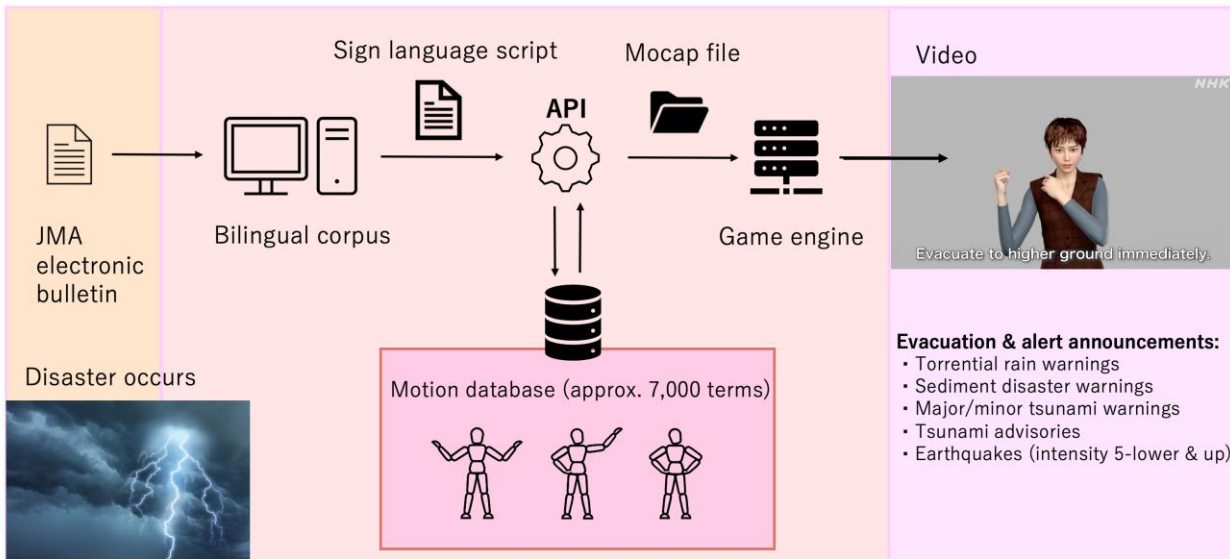
The strength of this service with the virtual human is that it is available 24 hours a day, 365 days a year, late at night or early in the morning. Based on data released by the Japan Meteorological Agency (JMA), the sign language CG is automatically generated, enabling users to promptly call for evacuation and warnings in sign language.



## OVERVIEW: AUTOMATIC GENERATION SYSTEM OF SIGN LANGUAGE CG

Overview of the automated CG sign-language generation system

NHK



"The Automatic Generation System of Sign Language CG" receives weather and disaster data released by the JMA and combines them with motion data expressing sign language movements to automatically generate CG animations.

First, the system translates the telegrams distributed by the JMA into a specific grammar of sign language using a bilingual corpus. Based on the translated data, sign language words are picked up from the motion database that contains approximately 7,000 basic sign language expressions. To smoothly connect the words, a CG animation is generated by using the Unity game engine.

Currently, the system is able to provide evacuation and warning information in sign language and Japanese subtitles immediately after life-threatening warning of heavy rain, landslide, earthquake, and tsunami. The system delivers sign language CG videos within about 1 minute after receiving the data and is currently under further development to shorten the delivery time.



## SIGN LANGUAGE BROADCASTS ARE NOT ENOUGH

The following is a summary of the weekly sign language broadcasting time on major broadcasters in Japan. NHK General Channel broadcasts 1 hour and 16 minutes, and NHK Educational Channel, which puts in effort of sign language broadcasting, broadcasts 4hrs and 8mins. When it comes to major commercial broadcasters in Tokyo and Osaka, they are 18mins and 13mins respectively. Considering the fact that each channel broadcasts 20hrs a day, 4hrs a week are not enough.

Sign language broadcasting	Sign language broadcast hours per week (average per station)
NHK (General Broadcasting Center)	1 hour 16 minutes
NHK (Education)	4 hours 8 minutes
Five key Tokyo stations	18 min.
Four semi-key stations in Osaka	13 min.

Reference: Ministry of Internal Affairs and Communications,  
"Actual results of subtitle broadcasts, etc. in fiscal 2021".

What kind of programs come with sign language interpretations? They are mainly news, documentaries, and educational programs. Among those programs it is critical to deliver information in sign language as clear and accurate as possible so that deaf and hearing-impaired people are able to understand them accurately. If the genre spreads more such as entertainment and sports programs, we all will be able to share the same excitement and joy with deaf and hearing-impaired people.

Speaking of "accessibility", the necessity of delivering information, not only with subtitles but also in sign language, is in line with the principle of the United Nations; "Leave no one behind". We believe that the sign language CG service can make a significant contribution to this principle. We want to create society where everyone can receive the same information in real time. As a first step, the sign language CG service has been launched on NHK's website.

## WHY DO WE NEED SIGN LANGUAGE?

"Why do we need to communicate in sign language?" "Aren't subtitles good enough?" Those are the voices that we have received during our development of this service.

Approximately 297,000 people with hearing disabilities who have a disability certificate live in Japan. However, it is said that there are potentially more people who need sign language such as hearing-impaired people without the certificate. For those who are deaf all their life, sign language is their mother language. Some of them do not read nor write Japanese; the others may understand Japanese, but not fully. That is why providing information in sign language is important, instead of Japanese subtitles, as it is easier for me to get information in Japanese, instead of foreign language. Therefore, when a disaster occurs, it is important to deliver information in sign language: the same information to all.



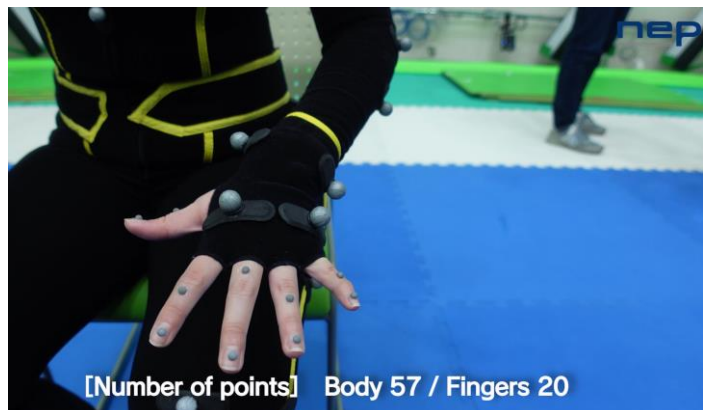
However, it is extremely difficult to have sign language interpreters on standby 24 hours a day, 365 days a year to respond to unpredictable disasters such as earthquakes and tsunami. As Japanese sign language interpreters are limited, about 4,000 people, it is impossible to let them on standby all the time.

Therefore, NHK Group has conducted research and development of "sign language CG" in which avatars play the role of sign language interpreters, instead of real people.

It is important to note that this service will not take away jobs from sign language interpreters. Complicated business meetings and multi-person conversations can be only handled by a professional interpreter so that the roles of sign language interpreters and the avatars are segregated.

## CAPTURING THE MOVEMENTS OF A DEAF PERSON

KIKI's signs are motion-captured from movements of a deaf person, word by word. The accuracy is critical in sign language computer graphics production so that to reproduce the detailed movements of sign language, 57 points were attached to the body and 20 to the fingers, and 64 sensors were used to capture the model's movements.



In addition to hand and finger movements, facial expressions and movements are also essential for sign language expression. A particular camera is used to capture the details of facial motions. KIKI's movements are generated by combining all of those motion data recorded in this way.

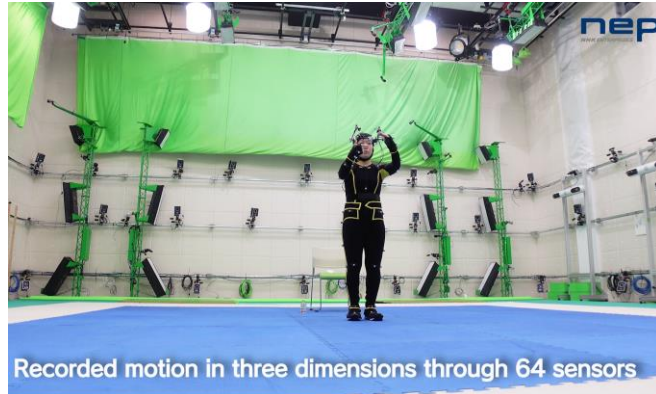


## ● SUPERVISED BY A DEAF UNIVERSITY PROFESSOR

The sign language CG service is supervised by Professor Yutaka Osugi at Tsukuba University of Technology. He is deaf himself and specializes in sign language linguistics.

In advance to filming motion capture, Pro. Osugi creates a video of the sign language movements to be recorded accurately and gives instructions to the model on site and reviews what's recorded and captured.

His detailed supervision is essential because sign language, a visual language, has different expressions based on the region where you live in just like dialects in spoken languages. This is why Pro. Osugi supervises the signs in studio that can be equally understood by people from different regions.



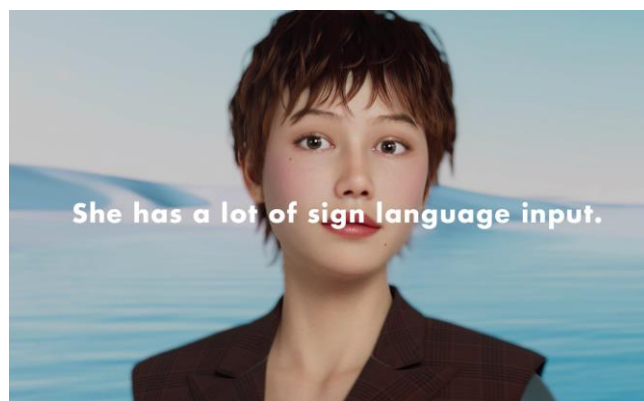
Professor Yutaka Osugi  
Tsukuba University of Technology

## NEW SKILLS: MULTIPLE SIGN LANGUAGES TO CONNECT THE WORLD

KIKI will be multilingual soon! Sign languages differ from country to country and region to region; for example, British sign language is different from Dutch sign language. We want KIKI to develop multilingual skills and become a virtual human who plays a role in all over the world.

In Japanese society, voice announcements in English, Korean, and Chinese have been popular lately. Likewise sign languages must be made multilingual, and information needs to be provided equally.

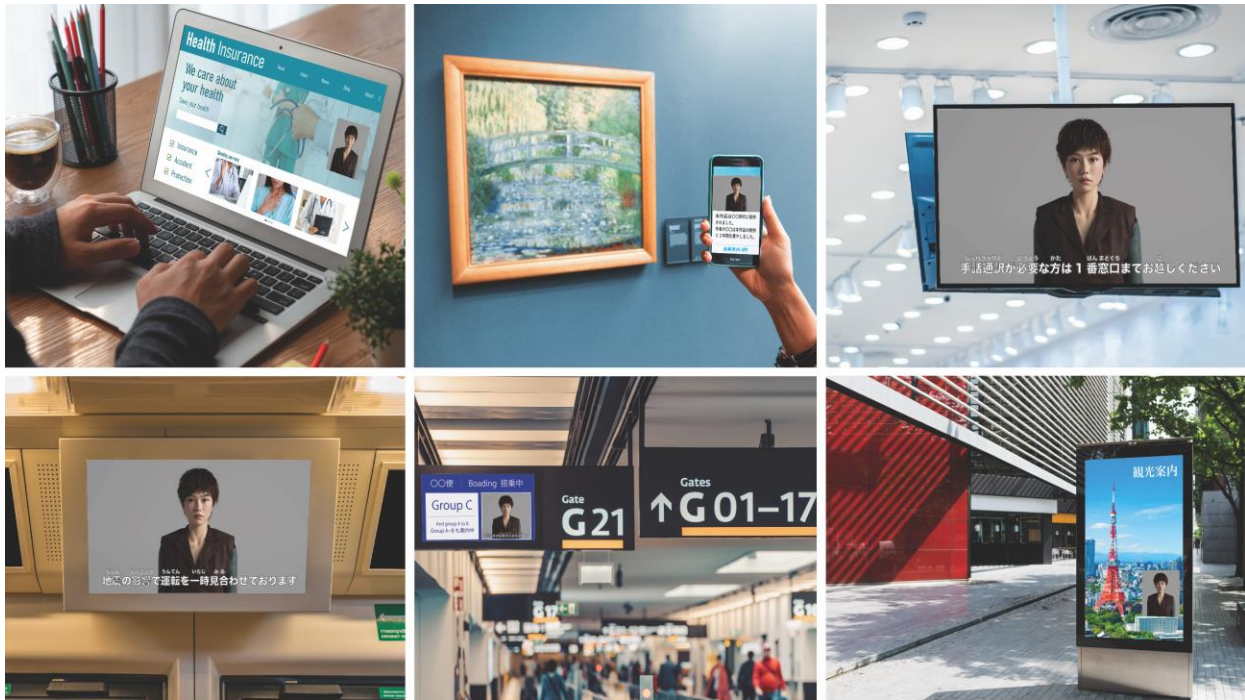
In 2025 Japan is hosting the World Expo and the Deaflympics. At such international events, we are considering the use of International Sign, lingua franca, for information dissemination. Targeting those events there is an urgent demand of recording words in new languages to build a multilingual word database. It is hard for a person to have such multilingual skills in sign language; however, it is possible for KIKI!





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## KIKI WILL NOT BE ONLY A SIGN LANGUAGE AVATAR



What kind of role can KIKI play in the future? We are now thinking of expanding sign language CG services widely in society, not only in TV but also at public facilities such as stations, restaurants, movie theatres, and so on. For example, at airport, KIKI will be able to announce flight schedules and boarding information in sign language. Or railroad companies may use KIKI to explain operation status in sign language based on Japanese texts. KIKI can play an important role at wherever needed.

It is a bit pity that there are so many occasions and places in which KIKI can get involved; it is the flip side of the current society that there are very few explanations in sign language.

Sign language CG services aim to create a society that information can be provided in sign language under any circumstances. Of course there are already some convenient services in Japan for deaf and hearing-impaired people. However, it is not enough yet; it would be a much more lovely society if everyone could enjoy information at the same level, no matter what kind of disabilities he or she has. We have produced KIKI to achieve such an inclusive society.





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## KIKI: A SYMBOL OF AN INCLUSIVE SOCIETY

Have you ever paid any attention to how deaf and hearing-impaired people live in our society? What is it like to communicate in sign language instead of voice? Although I was born in Japan and live in the same society as deaf people, I have had little contact with them. Our society should be not divided no matter what disabilities he or she has. In order to achieve an inclusive society, we need to approach "sign language" not only from the perspective of welfare, but also from the perspective of entertainment.



The first step is to get young people, the future generation, interested in KIKI and also in sign language. Her costumes can be designed by a leading fashion designer, and we can put more trends into her hairstyles and hair colouring, for example. We believe that adding cultural values to KIKI can create a "connection" with people who have never been a part of the deaf community before. We will continue to promote sign language CG services so that KIKI can become a symbol of an inclusive society.

## A NEW WORLD WITH KIKI

Let me conclude by stating our hope. Our main goal of this sign language CG project is to give awareness to "physically healthy people". Why are virtual human sign language interpreters such as KIKI needed? If he or she wonders like that, it will be the first step to achieve an inclusive society.



This project is a combination of "building a society to understand deaf" and "technological innovation that enables accurate sign language expression". I believe promoting on both ways will bring us closer to the realization of the inclusive society we are striving for.