**9. An effective sign language learning with object  
detection based ROI segmentation**

There have been many studies about sign language for communicating with the hearing impaired. Recently, there have been machine learning based approaches with convolutional neural network (CNN) and low cost 2D camera. In the proposed method, hands are considered as objects and as the detection network for them, YOLO is employed. Once the hand areas are distinguished, background becomes negligible and there is no need to put massive data of various situations into the training model. In the sign language learning process, convolutional neural network is used, which is known to perform well for image classification problems.

The YOLO has relatively faster learning speed as well as high accuracy. The goal of the object detection network is obtaining the probability vectors of the classes. The overall process is shown in the lower part of Fig. 1. The proposed method requires relatively less data and it is more convenient to learn additional sign gestures.

The conventional sign language learning system has two drawbacks. The first is that the area of hand is so small that the training data should be large. The second is that it is hard to extend the data set for adding a new gesture to be learned. To solve these problems, we introduced a new sign language learning method that extracts hand area as the ROI before learning, using object detection network.