Development of robot vision artificial intelligence that can recognize even unlearned objects

— Professor Kyoobin Lee's team achieved the world's highest performance by developing an AI that accurately detects unlearned objects even in a complex robot environment through occlusion relationship inference

— Bronze Award for Samsung Human Tech Papers Awards and will be presented at ICRA 2022, the world's most prestigious robotics society

▲ Professor Kyoobin Lee's research team in the School of Integrated Technology

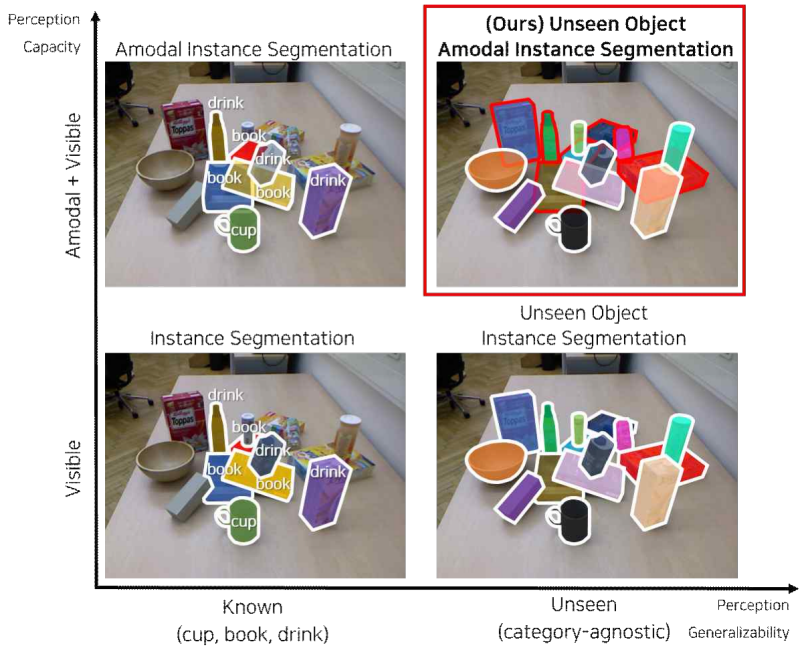
GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Integrated Technology Professor Kyoobin Lee's research team developed a deep learning technology that simultaneously detects the visible, invisible, and occlusion of an unlearned object even in a complex robot environment through hierarchical occlusion modeling.

This study, in which Ph.D. student Seunghyeok Back participated as the first author, achieved the world's best performance in the field of unlearned object recognition and was awarded the bronze medal at the Samsung Human Tech Papers Awards. The thesis will be presented at the International Conference on Robotics and Automation (ICRA) 2022, the world's most prestigious robotics society.

For a robot to manipulate an object in a new environment, it is necessary to accurately detect an unseen object that has not been learned in advance. Instance segmentation, which detects a region for each object from an image, is a core

research area of deep learning and robot vision, but various studies have been proposed. There was a limit in that only objects of the previously learned category could be recognized or only the visible region of unlearned objects could be detected.

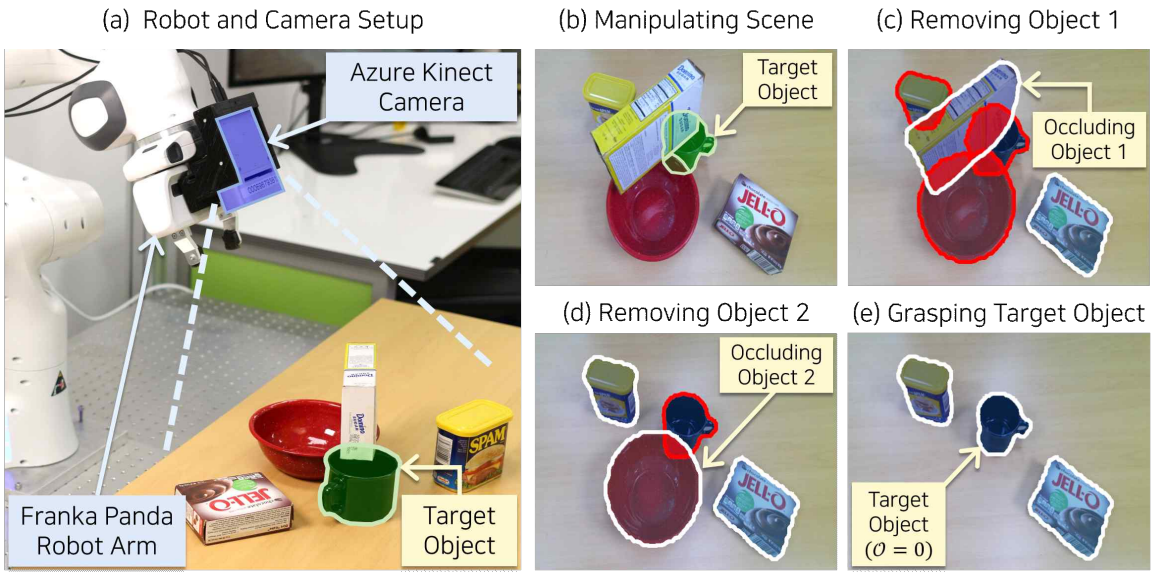
To solve this problem, the research team has developed and proposed a new task called Unseen Object Amodal Instance Segmentation, which aims to detect not only the visible area of the unlearned object but also the occluded area at the same time.



▲ Amodal instance segmentation of unlearned objects proposed in this study and comparison with previous studies

In addition, the research team proposed Hierarchical Occlusion Modeling to effectively consider the occlusion relationship between objects, and they disclosed new virtual and real environment datasets to learn and evaluate it.

The algorithm proposed by the research team achieved world-class performance on three datasets, confirming that it can significantly improve robot recognition performance in complex environments. In addition, it was confirmed that a robot can be used for various tasks by using it to grip (hold in the hand) the hidden target object.



▲ A method of planning to hold a hidden object by a robot using the proposed algorithm

Professor Kyoobin Lee said, "Through this study, it was confirmed that even if a new object is given in a complex atypical environment, it can recognize not only the visible area of the object but also the hidden area. Unlearned object recognition is expected to be utilized as a core technology in the field of robotics to apply robots to various environments such as factories and homes."

This research, conducted by Professor Kyoobin Lee's team at GIST, was supported by the robot industry core technology development project of the Ministry of Trade, Industry and Energy and received computing operation support from the national AI data center service and high-performance computing resource support project of the Ministry of Science and ICT and the Information and Communication Industry Promotion Agency. The code and dataset used in the study can be downloaded from the open source repository (https://github.com/gist-ailab/uoais).

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